LYNX 470 USERS MANUAL

TECHNOLOGY INC.

This manual has been written for use with the LYNX 470 floppy disk drive alignment tester and exerciser. Examples of indications for alignment measurements are based on the specifications of the majority of disk drive manufacturers. Consult your manufacturer's service manual for exact specifications.

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LYNX 470 - USERS MANUAL

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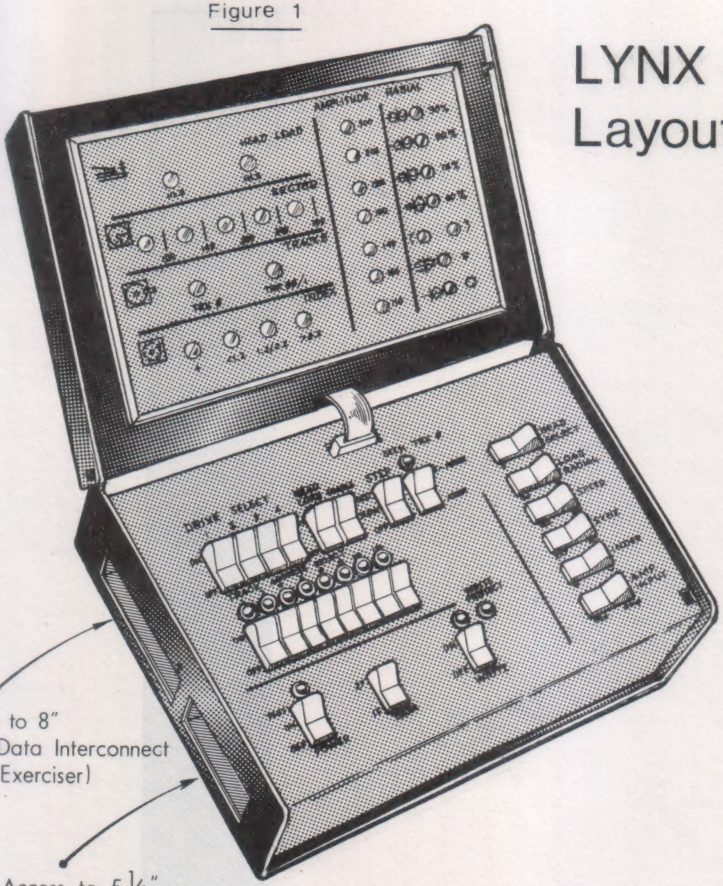
Section 1

Figure 1

LYNX 470 Layout

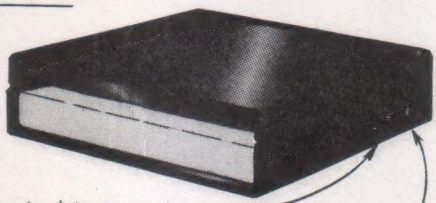


Access to 8"
Drive Data Interconnect
(Exerciser)

Access to 5 1/4"
Drive Drive Interconnect
(Exerciser)

CLOSED VIEW

Figure 1A



Access to Interconnect
(Alignment tester)

Access to Magnetic
Circuit (Re et Breaker

SECTION 1

1A

INTRODUCTION

This manual has been produced for use in conjunction with the LYNX 470 alignment tester and exerciser. The LYNX 470 is a direct access tool utilizing industry standard alignment diskettes to provide all major functions required in field alignment and troubleshooting procedures.

- SECTION 1 provides general information about the LYNX 470 - power requirements and physical specifications.

- SECTION 2 offers information about disk drives - components, theory of operation, etc. The manufacturer's service manual, however, should be consulted for specific data about the drive under test.

- SECTION 3 discusses the function of each switch on the LYNX 470 control panel and the range of LED indications possible on the display panel. Specifications are included in the appropriate sections.

- SECTION 4 is the primary operating guide when using the LYNX 470. This section should be consulted for initial set-up of the 470, test point connection, alignment and troubleshooting procedures, interpretation of the LYNX 470 LED displays, etc.

- SECTION 5 contains the warranty for the LYNX 470 and other useful service information.

1B POWER REQUIREMENTS

The LYNX 470 requires external power from the disk drive PCB of +5 volts. External connectors provide easy access to power the LYNX unit. The LYNX 470 is protected by a magnetic circuit breaker rated at 1.0 amp. See Figure 1A. Reversal of polarity or extreme voltages will cause the breaker to trip until correct voltages and polarity are applied. Please exercise CAUTION on hook-up procedures. Recommended procedure is to find correct voltage with voltmeter or multimeter before actual hook up. Depower the drive before connecting or disconnecting any cables.

1C PHYSICAL SPECIFICATIONS AND ACCESSORIES

COMPOSITION: 16 gauge steel

SIZE:

	OPEN	CLOSED
Width:	21.6 cm/ 8.5"	21.6 cm/ 8.5"
Length:	34 cm /13.5"	17.5 cm/ 6.75"
Height:	3 cm / 1.2"	5.5 cm/ 2.1"

WEIGHT: 1.93 kg./4.25 lbs

CALIBRATION: 2000 hrs. operational standard.

DISPLAY: High intensity LED's.

POWER: +5 volts required from source drive under test. 500ma typical draw.

ENVIRONMENT: 5°C to 40°C operative.
-35°C to 60°C storage at 80% relative maximum humidity (non condensing) over operating range.

ACCESSORIES: Users manual
5 1/4" exerciser cable
8" exerciser cable
Universal Alignment cable

OPTIONAL: Carrying case
Universal test clips
Osborne Adaptor
Apple Adaptor
Alignment Diskettes

Section 2

SECTION 2

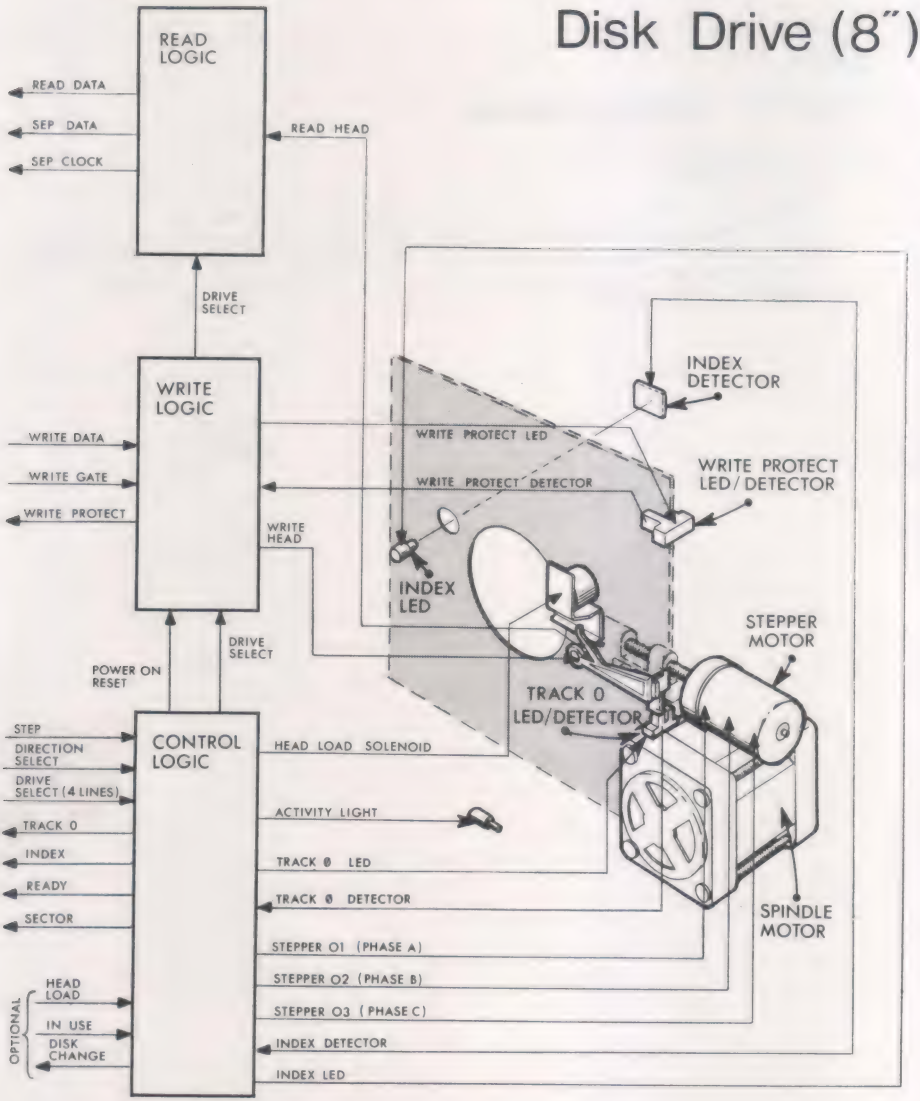
DISK DRIVES - GENERAL INFORMATION

2.A INTRODUCTION

Although there are many types of drives, varying in specifications drives have many elements in common. Following are those GENERAL similarities. To acquaint yourself with the SPECIFICS of a particular drive, the manufacturer's manual must be consulted.

Figure 2

Basic Disk Drive (8")



2.B MAJOR COMPONENTS

All disk drives share a basic design since they all perform similar functions. The major components of a disk drive are:

(Refer to Figure 2 as you read the following sections.)

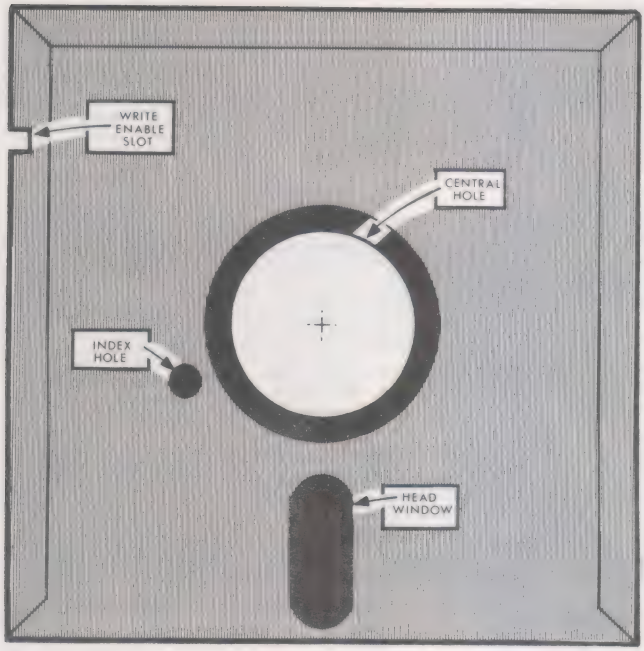
2.B1 The SPINDLE is driven by the SPINDLE MOTOR which will start the spindle rotating when the appropriate control signals (e.g. ENABLE ON) are received. The diskette, centrered on the spindle, is rotated at either 300 rpm (5 1/4" diskette) or 360 rpm (8" diskette).

2.B2 In the case of single-sided drives, when the HEAD LOAD SOLENOID is energised by current from the head load circuits, it is activated to enable a HEAD LOAD PAD to press the diskette against the head. If the solenoid is defective (twisted, bent, etc.), there will not be enough pressure against the diskette and the READ/WRITE HEAD cannot perform its functions. For double-sided (dual head) drives, the diskette is clamped between the two heads, and the user selects the head (side) to be used. In some drives, head load is automatic with door closure.

2.B3 Positioning of the R/W head is accomplished by a LEAD SCREW driven by the STEPPER MOTOR or a metal bank. Each STEP command from the host system increments the stepper motor which, in turn, moves the R/W head one track position. Therefore, assuming a starting position of Track Ø, five pulses from the host moves the head to Track 05. When the head is moved (stepped) towards the spindle, it is said to STEP IN, if the head is stepped away from the spindle, it is said to STEP OUT.

Figure 3

Floppy Diskette (Soft - sectored)



2.B4 The READ/WRITE (R/W) HEAD contains three coils - two R/W coils and one erase coil.

During a write operation, the erase coil is energised, causing the outer edges of the track to be erased, preventing the data being written from exceeding the parameters of the track and spilling over onto neighbouring tracks. This is called trimming or tunnel erasing.

Each bit written results in a change in the direction of current flow through the R/W head, producing a change in the flux pattern for each bit. The current through either of the R/W coils causes the erasure of old data as the new data is recorded.

During a read operation, the direction of the flux changes on the diskette surface passing under the gap. The data will be converted to digital form (voltage outputs) to be interpreted by the host system.

2.B5 Refer to Figure 3.
A small hole called the INDEX HOLE is punched on the inner edge of the diskette. The diskette rotates between a light source (LED) and sensor, these two components comprising the INDEX SENSOR ASSEMBLY. When the index hole in the diskette rotates over the light source, the light is detected by the sensor. The sensor output is amplified and transmitted to the controller/host as the INDEX PULSE. The (INDEX PULSE) indicates the beginning of each track.

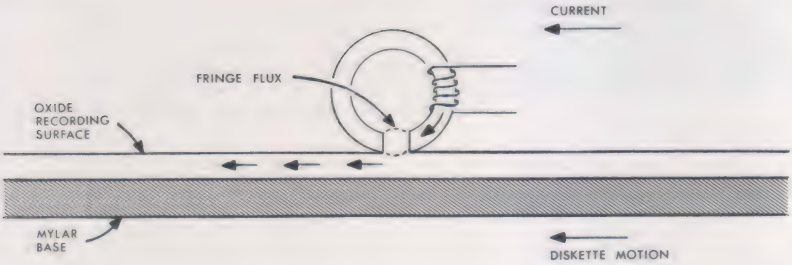
2.B6 In other words, the index is a timing mark. A further refinement of diskette timing is the use of SECTORS. In some diskettes, 32 sector holes, (variations include 8 or 16 sector holes),in addition to the index hole, are punched along the same circumference as the index hole, dividing each track into 32 equal parts called sectors. This type of diskette is referred to as hard-sectored.

For soft-sectored diskettes (e.g. alignment diskettes), the designation of sectors is resident in the software. The records are preceded by unique identifier (address) assigned by the user.

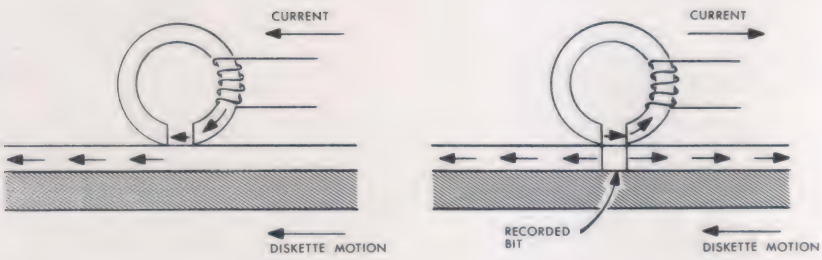
2.37 The PRINTED CIRCUIT BOARD (PCB) holds the intelligence or logic of the system. The functions performed by a system - disk drive, printer, LYNX 470, etc. - are determined by the circuitry designed for the board(s) comprising it. PCB's are also referrred to as PCA's (PRINTED CIRCUIT ASSEMBLY), or more simply "boards" or "cards".

Figure 4

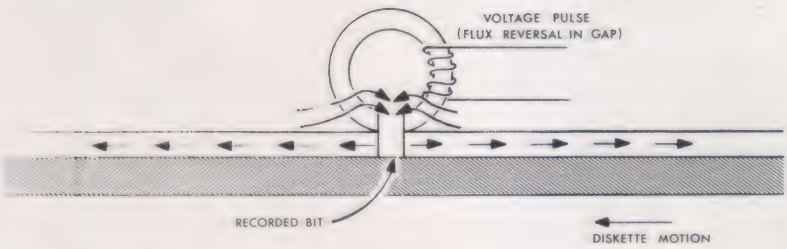
Basic Read/Write Head



Recorded Bit



Reading a Bit



2.C BASIC FUNCTIONS/THEORY OF OPERATION

2.C1 Disk drives have three basic functions:

- CONTROL - receive/interpret and generate control signals
- POSITION - position the READ/WRITE (R/W) head on the selected track
- R/W - read or write data upon command

2.C2 To examine the theory of operation, let's follow a typical WRITE, then READ operation.

2.C3 Assuming that: a diskette is loaded and up to speed; the head(s) is loaded and positioned; and a particular drive is selected, then:

2.C4 To WRITE on the diskette, WRITE ENABLE is sent by the controller/host to condition the write logic. Input to the READ circuits is blocked. When the WRITE DATA command is received, the write current then in the R/W head, reverses polarity synchronous with the low - to - high transitions of the WRITE DATA pulses from the host/controller. The current reversals cause magnetic flux reversals and the desired track is coded with the data bits.

2.C5 Erasure of previously recorded data is accomplished simultaneously during the WRITE operation. In additon, a delayed tunnel-erase is performed, sweeping the intertrack area, so that noise is reduced and the data on the selected track does not spill over onto other tracks - the tracks are trimmed to maintain their specified width.

2.C6 When the head(s) is loaded and a write operation is NOT occuring, the READ operation is assumed.

2.C7 The data (flux reversals) sensed by the R/W head is fed to the READ DATA CIRCUIT. The signal (data) is amplified, filtered to reduce noise, and converted into digital form. The controller/host receives and interprets these signals.

2.D TYPES OF ERRORS

In this section, the general types of errors will be discussed. For specific error conditions, refer to SECTION 4 of this manual.

2.D1 There are basically three types of errors:

- SEEK ERRORS
- WRITE ERRORS
- READ ERRORS

2.D2 SEEK ERRORS: occur when the drive is unable to:

- access a particular diskette side or track.
- sense Track Ø

Seek errors generally occur when there is a malfunction of the stepper motor which causes the stepping rate or the physical position of motor to be significantly altered. An alignment procedure must be performed. If such a conditon exists, either the head will not step at all, it may step to the incorrect address, or it may step in the wrong direction. If the stepper motor is good, the controller PCB for the stepper motor may be defective. See SECTION 4 for other possible causes.

2.D3 WRITE ERRORS: occur when the drive is unable to write data onto a diskette.

If an error occurs during a write operation it can be detected by performing a read operation, commonly called a "write check". After performing a manufacturer's specified series of write and write checks (anywhere from four to ten), and data cannot be written successfully, a write and write check should be performed on an alternate track. If more than two tracks are defective, the diskette should be replaced. If, with a second diskette, the error persists, the drive may be defective.

For specific alignment and troubleshooting procedures, see SECTION 4.

2.D4 READ ERRORS: occur when the drive is unable to recover data (read) previously written onto a diskette.

If the manufacturer's specified number of attempts (up to ten) to read the data on a track are unsucessful, refer to SECTION 4 for alignment and troubleshooting procedures.

Section 3

SECTION 3 OPERATING MODE CONTROLS/INDICATORS

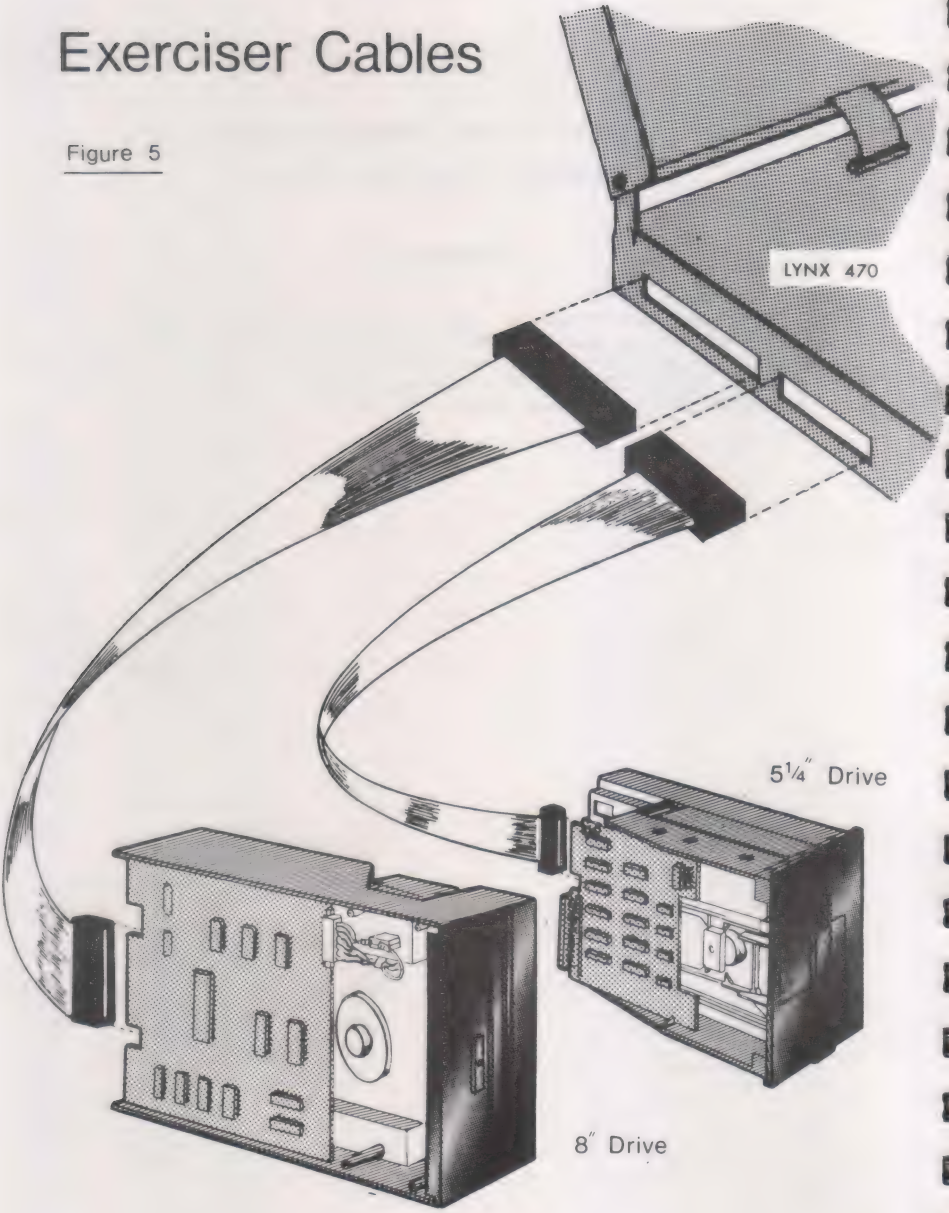
SWITCH FUNCTIONS/LED DISPLAYS

3A INTRODUCTION

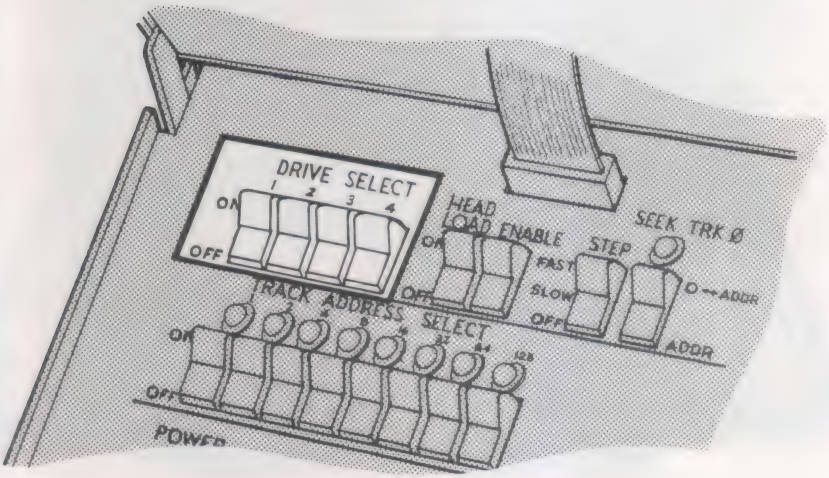
This section discusses each of the switches and LED indicators on the LYNX 470. SECTION 3B explains the lower half of the 470 which comprises the control panel of the unit, while SECTION 3C explains the LED indicators on the upper half or display panel of the 470.

Exerciser Cables

Figure 5



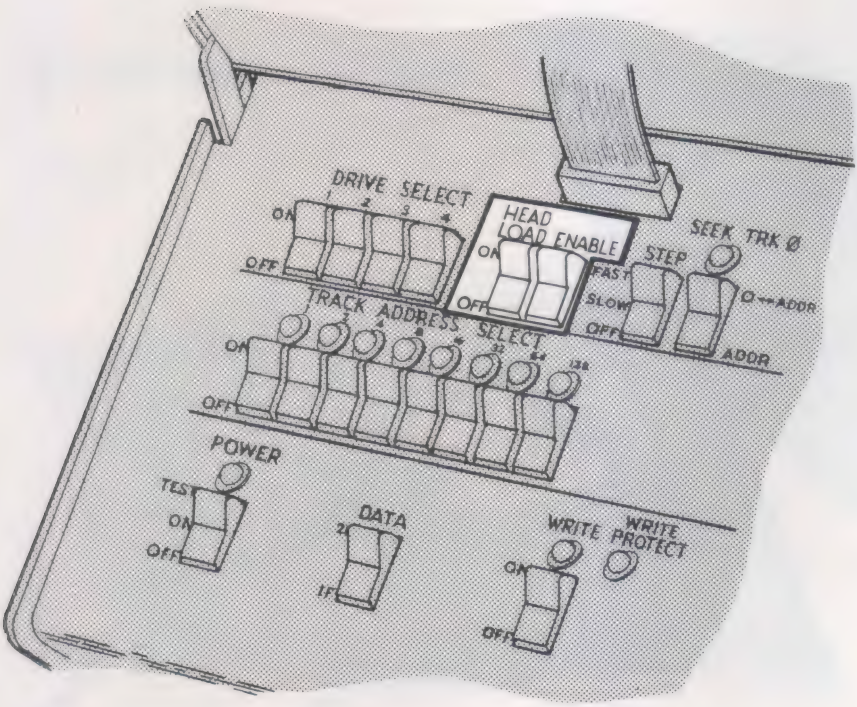
3B SWITCH OPTIONS - CONTROL PANEL



3B.1 DRIVE SELECT

This series of switches allows the selection of the drive under test. When the activity LED on the front of the drive is lit, the correct drive has been selected. Only one drive should be selected (enabled) for testing at any one time.

NOTE: The selection of a drive with the above switches will be all that is required to enable a drive for most 8" drives and some 5 1/4" drives. However, some drives (8" or 5 1/4") require "ENABLE" set to "ON" in conjunction with the appropriate DRIVE SELECT switch and the HEAD LOAD switch.



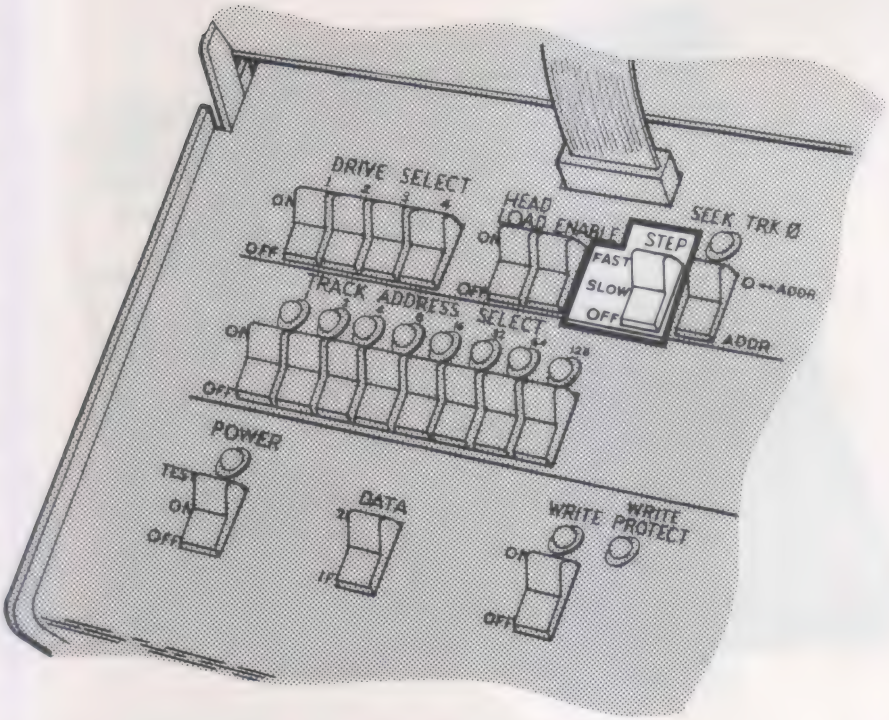
3B.2 HEAD LOAD

When set to "ON", this switch loads the head, that is, brings the head into contact with the diskette surface. Certain dual head drives require that the second head be loaded and unloaded by the Host system. This switch provides the option to simulate the Host function.

3B.3 ENABLE

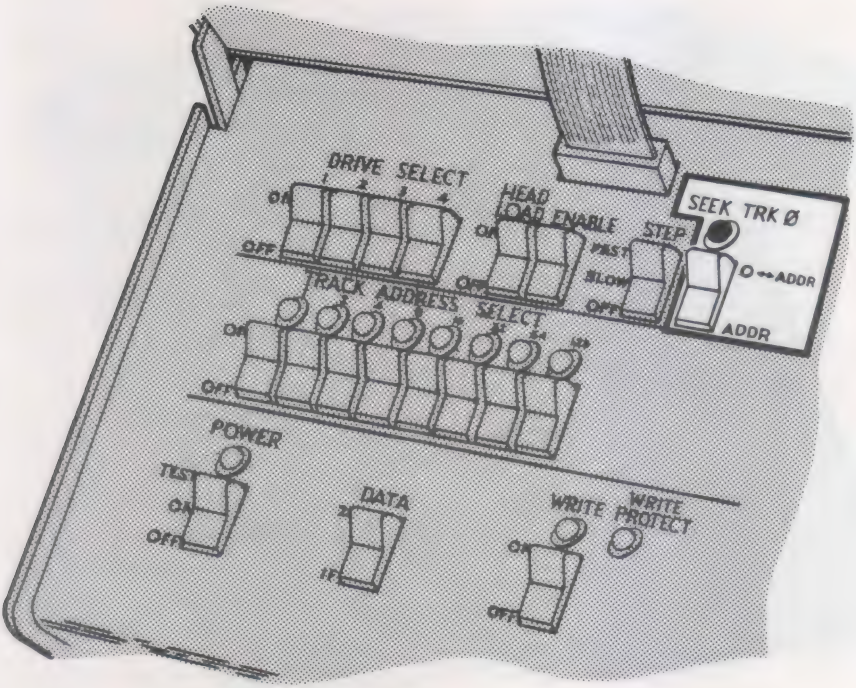
Most 8" drive motors will rotate continuously whether ENABLE is set to "ON" or "OFF". However, some do require this switch set to "ON" to enable the drive.

Most 5 1/4" drives are turned on and off by the Host system. The ENABLE switch set to "ON" and HEAD SELECT set to "1" or "0" allow the simulation of the Host function to enable the 5 1/4" drives for testing. Some 5 1/4" drives rotate independently of this switch.



3B.4 STEP

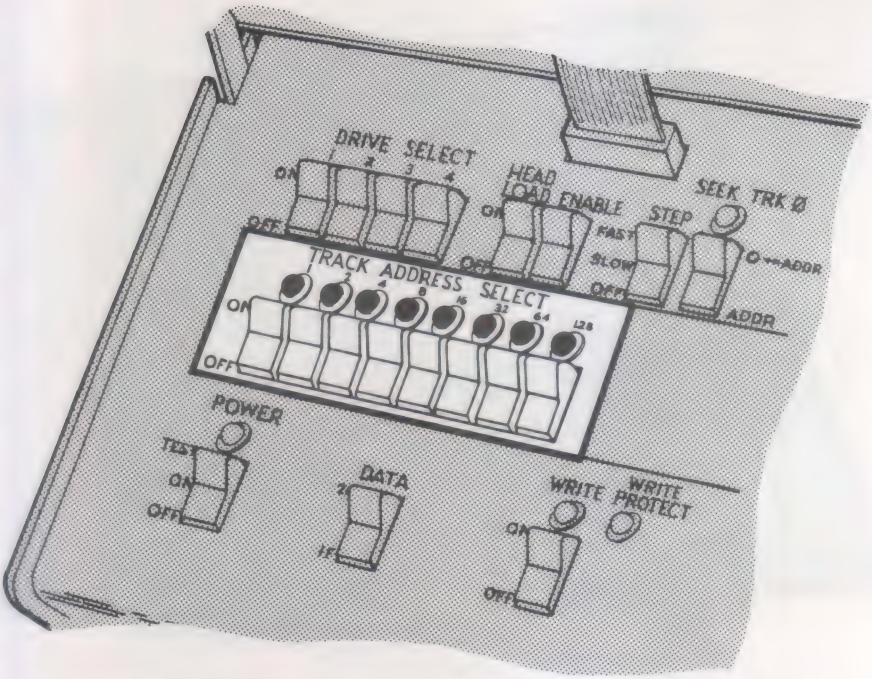
When set to "FAST", the head will move quickly to the selected address at a rate of 20 milliseconds (ms) per track The "SLOW" setting will also move the head to the selected address but at a rate of 80 ms per track. This slower rate makes it possible to count the tracks to verify the head position which is helpful during some troubleshooting procedures. If this switch is set to "OFF" the drive will not step. Further, if the WRITE switch is on, STEP is disabled.



3B.5 SEEK TRACK Ø

When this LED is lit, the drive is indicating to the Host System CPU that the head is on Track Ø.

When the switch is set to "Ø ↔ ADDR", the head will step from Track Ø to the selected address and back to Track Ø. This stepping sequence will continue indefinitely. When set to "ADDR", the head will step to the selected address and remain there.

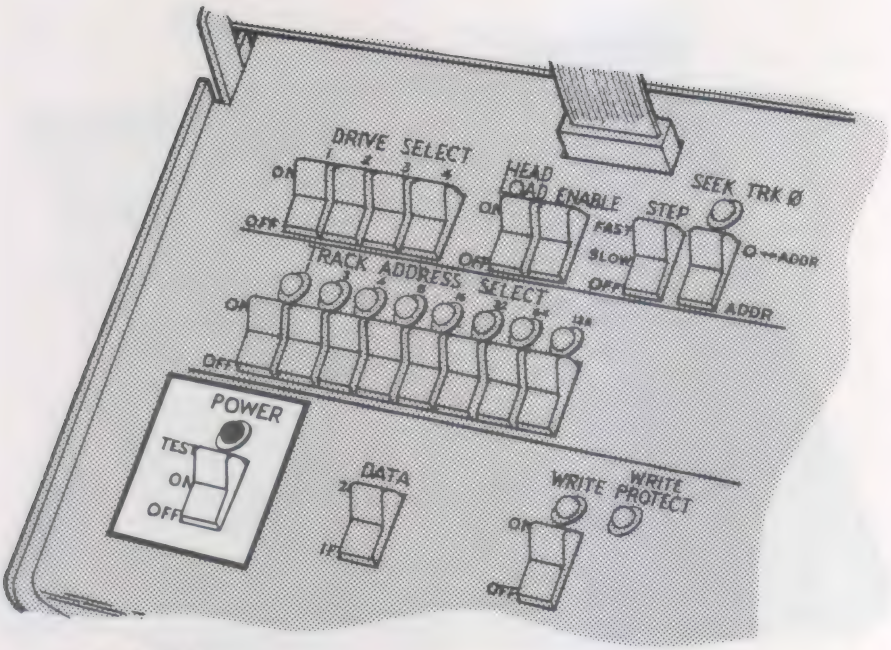


3B.6 TRACK ADDRESS SELECT

This group of switches select and indicate the track which the head is currently contacting. If all switches are set to "OFF", TRACK Ø is selected. The combination of switches set to "ON" should add up to the desired track. The LED's above the switches will light in a binary count sequence as the head moves to the selected address, and will remain lit above the switches set to "ON" once the track is reached.

Examples: 2 - "ON" = Track 2 (all other switches - "OFF")
16 - "ON" = Track 16(all other switches - "OFF")
2, 4, 32 - "ON" = Track 38(all other switches - "OFF")
4, 8, 64 - "ON" = Track 76(all other switches - "OFF")

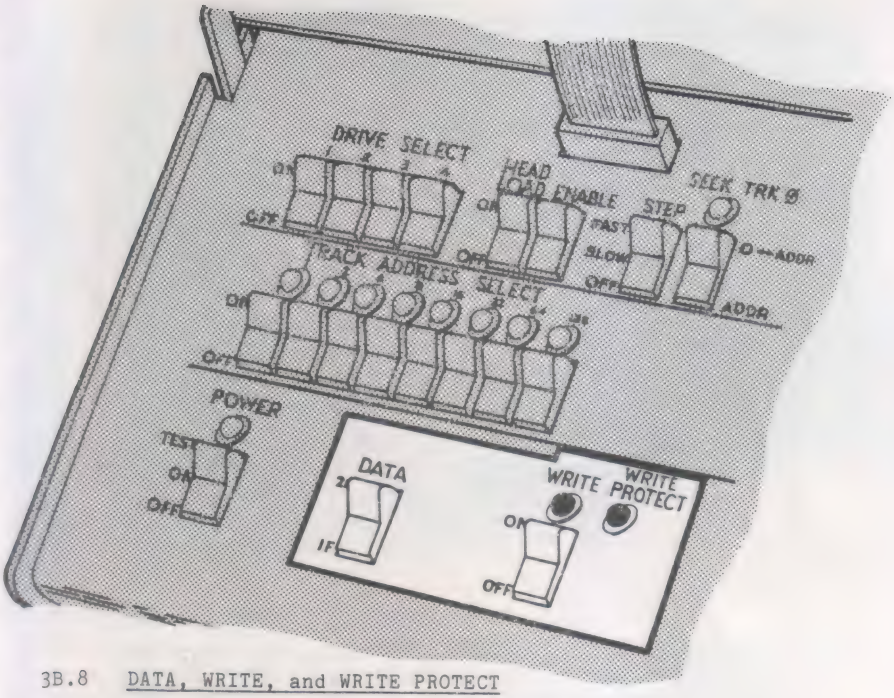
Combinations from 0 to 255 are possible.



3B.7 POWER

When this 3-way switch is set to "ON", the LED will be lit, indicating that the LYNX 470 is powered. When the LED is green the power level is acceptable. However, when the LED is red, the circuit breaker has been tripped and the power source should be checked. If STEP, ENABLE (optional) and HEAD LOAD are also set to "ON" and HEAD SELECT and DRIVE SELECT are activated, the power on sequence will restore the head assembly to Track Ø, and then step to whatever track address is selected. The track address may have been selected prior to setting the switch to "ON". If no address is selected, the head assembly will remain at Track Ø. The LED will remain lit as long as power is supplied.

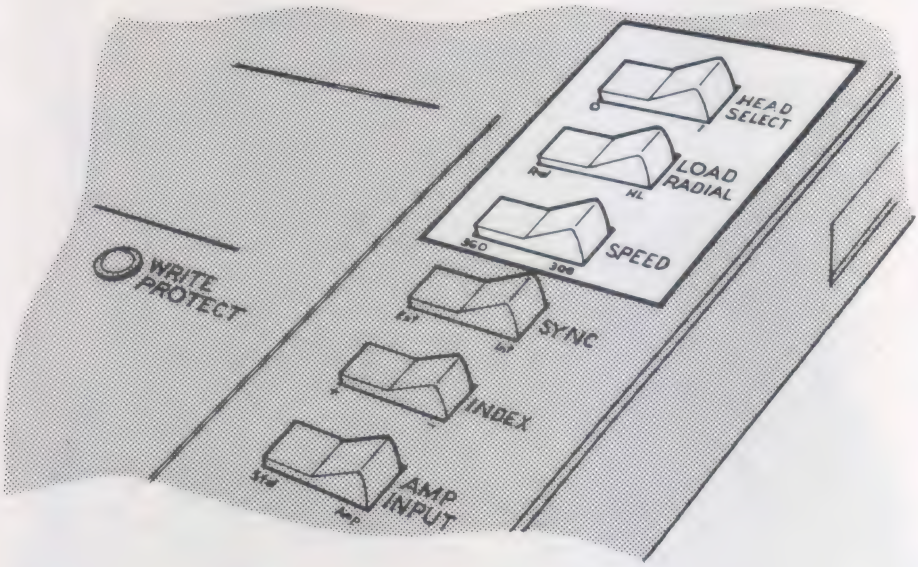
When set to "TEST", all the LED's on the LYNX 470 will be lit - an integrity check (see SECTION 4B.2). The switch, at the completion of the LED test, will reset itself to "ON".



3B.8 DATA, WRITE, and WRITE PROTECT

The combined use of the WRITE and DATA switches allow the writing of a 1F and 2F pattern on the diskette. After selecting the desired pattern, the WRITE switch is set to "ON". During the write operation, the LED above WRITE will remain lit until the switch is set to "OFF".

If the diskette is protected, the WRITE LED will remain unlit, the WRITE PROTECT LED will be lit, and a write operation will NOT occur.



3B.91 HEAD SELECT

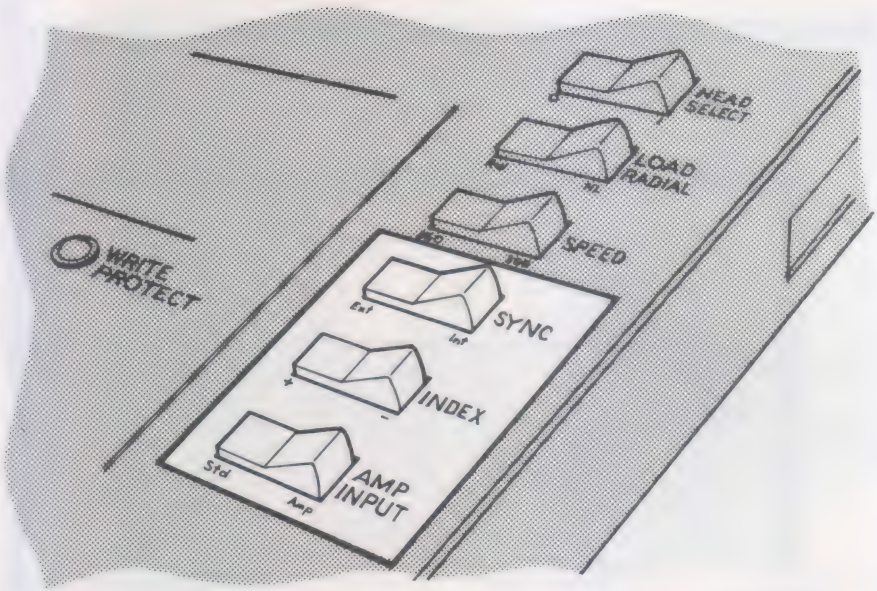
This switch will select the desired head on dual-sided disk drives. In some drives, the HEAD SELECT is optioned out either by the user or manufacturer and tied into another location. The brown lead on the alignment cable (FIGURE 8) is required to perform HEAD SELECT with the LYNX 470. (See SECTION 4E.2 - Test Lead Guide - NOTES)

3B.92 LOAD RADIAL

For measurement of Head Load Bounce (HLB) or Head Load Scan (HLS), the switch is set to "HL". For all other measurements, set to "Rd" (Radial).

3B.93 SPEED

This switch is set to "360"rpm for 8" drives or "300" rpm for 5 1/4" drives.



3B.94 SYNC

The "Int" (Internal) Sync is selected when testing drives without Index Sensor assemblies (e.g. APPLE DISK II) The "Ex" (External) setting applies to all other situations.

3B.95 INDEX

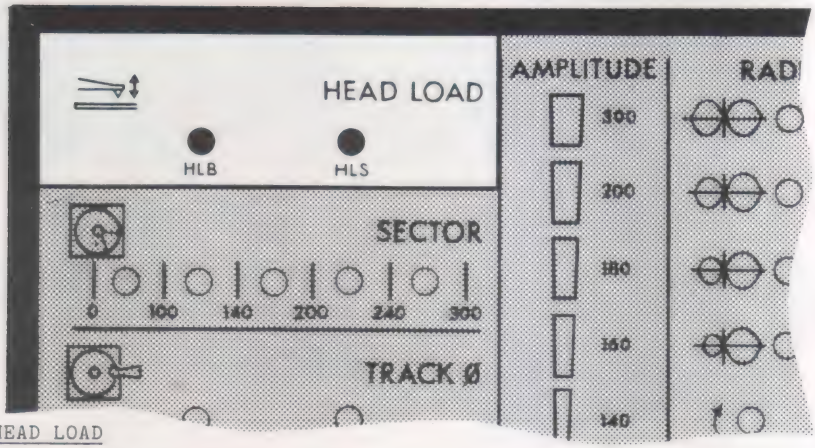
During Index adjustments, this switch is set to "+" when measurement is taken at the rising edge of the Index pulse (most 8" drives) and set to "-" when measurement is taken at the falling edge (most 5 1/4" drives). Refer to Figure 6. Manufacturer specifcations should be followed.

FIGURE 6

3B.96 AMPLITUDE INPUT

Most drives will require the "Std" (Standard) setting. In some drives the output signal at the testpoints is amplified. If this is the case, set the switch at "Amp". This setting attenuates NOT amplifies the signal. Again, check manufacturer's specifications.

3C DISPLAY PANEL



3C.1 HEAD LOAD

HEAD LOAD BOUNCE (HLB)

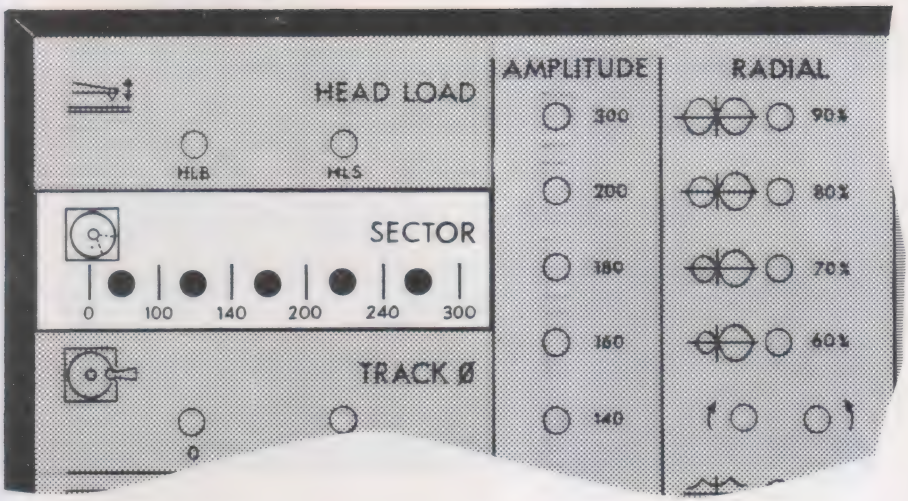
HEAD LOAD SCAN (HLS)

HLB and HLS are two conditions which may exist during the HEADLOAD operation. This applies to double sided drives loaded by electromagnetic solenoids only. Both are tested with the same circuitry and if either or both conditions exist, the appropriate LED(s) will light.

If there is insufficient pressure by the head on the diskette surface (defective solenoid), the head "bounces" on the diskette, damaging the data recorded there. The HLB LED will light.

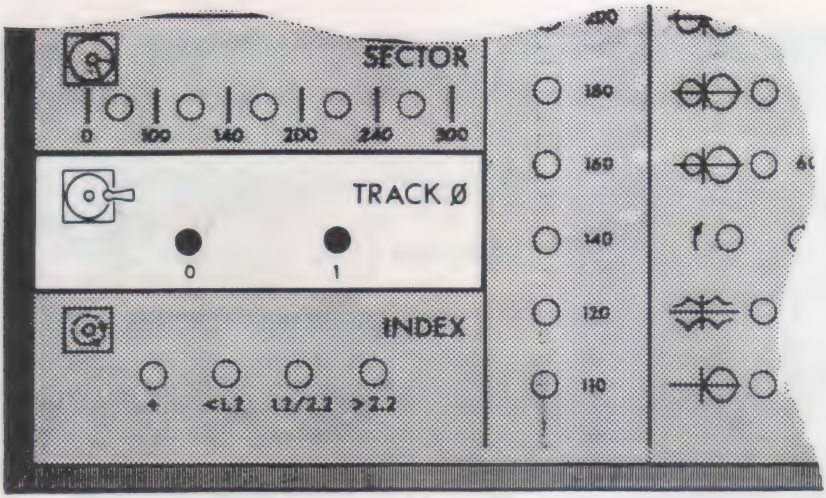
HLS measures the time elapsed from the point the drive is enabled to the first appearance of data on the diskette. If the data is presented too soon (defective solenoid) after drive select, the HLS LED will light.

Any HLS or HLB detected is trapped in memory. However, after deselecting the drive, making the necessary adjustments and reselecting the drive, the memory is cleared and reprogrammed (by drive deselect) to provide current measurements.



3C.2 SECTOR

This series of LED's indicates the time period (in microseconds) between the leading edge of the Index pulse (when it first appears) and the occurence of the leading edge of the first data pulse - the Index to burst measurement. Generally, the specification for most drives is 200 $\mu s \pm$ 100 μs. Each LED represents a "window" or an interval during which a circuit is open to permit signal sampling. For instance, the LED between 100 and 140 indicates a window of 40μs duration, the LED between 140 and 200 indicates a window of 60 μs duration and so on. The green LED's indicate an optimum reading for the leading edge of the first data pulse; the amber LED's indicate a slight adjustment is required; and the red LED indicates that the data pulse is too soon.

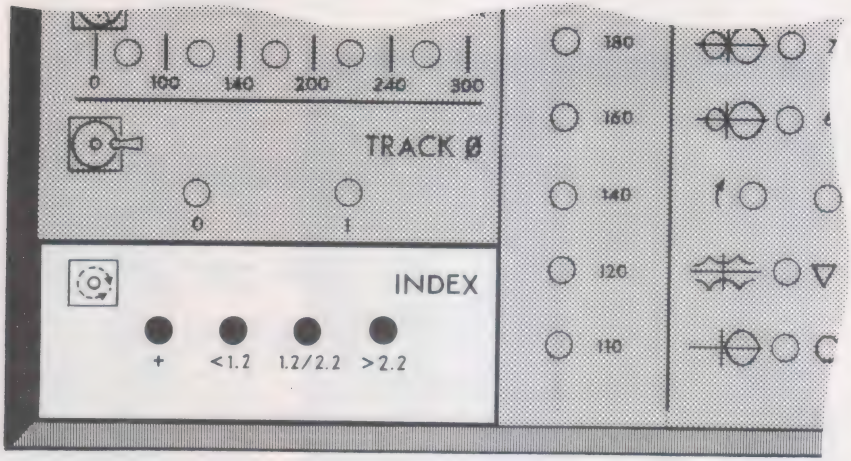


3C.3 TRACK Ø

These LED's are indicators of the state of the Track Ø sensor assembly internal to the drive. If the sensor assembly is operating correctly, either one of the LED's will be lit when the head is in the proximity of Track Ø. (See NOTE). One of these LED's must be lit before the SEEK TRK Ø LED on the control panel of the 470 lights (sending an O.K. to CPU). However, the TRK Ø and SEEK TRK Ø may appear to light simultaneously.

These two LED's also function as a TTL logic probe: the LED labelled "0" will light if a low signal (<.8 volts) is detected, while the LED labelled "1" will light if a high signal (>2.4 volts) is present. If neither LED lights, the signal level is not at acceptable TTL levels.

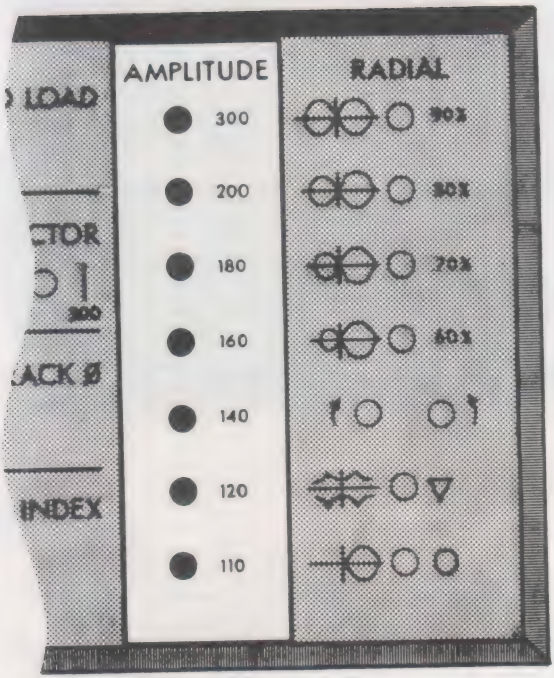
NOTE: For some drives, the TRK Ø LED remains lit and goes OFF when the head is on Track Ø. A few moments after it goes OFF, the SEEK TRK Ø LED will light.



3C.4 INDEX

This group of LED's indicates the presence of the Index pulse (the Index sensor assembly is operational) and measures the duration (in milliseconds) of the Index pulse. Most manufacturers of 8" drives specify a 1.2 to 2.2 ms signal as good, while 5 1/4" drives require a 2.2 reading. If the sensor assembly is faulty, the (+) LED will not light and readings on any of the other LED's are meaningless. If the Index pulse is not detected, read/write operations cannot take place. The Index indication is valid at all times except during HEAD LOAD.

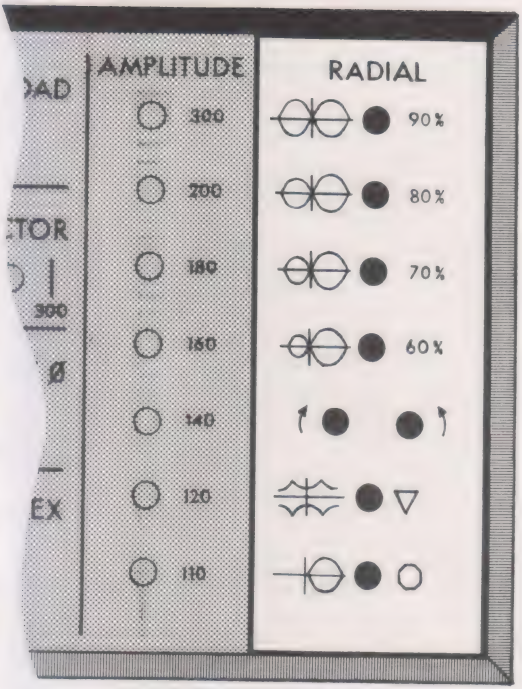
3C.5 AMPLITUDE



This group of LED's indicates the strength (in millivolts) of the signal detected by the R/W head. When the head is positioned on a track with a 1F or 2F pattern written on it and a read operation is initiated, the amplitude LED's should indicate the minimum peak-to-peak voltage for the drive under test.

The 110 LED will light AMBER since, in most cases, 110 millivolts is insufficient voltage. The service manual for the drive under test should be consulted. All other readings could indicate sufficient voltage dependent on the drive. Again, check the service manual.

3C.6 RADIAL



For optimum data transfer and retrieval, the R/W head must be positioned at the centre of each track within specified tolerances. One track of an alignment diskette (See SECTION 4B.1) has a radial alignment signal (cat's eyes) written on it designed to verify that these specifications are met.

The RADIAL group of LED's indicates the relative size of each lobe of the signal. The LYNX 470 compares signal size at each peak as a percentage of the other. The directional arrows ( ) indicate the left/right lobes. Once the comparison is made, the % LED's (60% - 90%) will light and the smaller lobe's LED will NOT light.

If the size of either lobe is at least 60% of the other, the % LED's and the larger lobe's LED will light. If either the ○ (threshold) or ▽ (zero-crossing) LED's are lit, all other LED indicators are invalid. For a complete illustration of various LED combinations, refer to SECTION 4D.

Section 4

SECTION 4 OPERATING PROCEDURES

4A INTRODUCTION

For the most effective employment of the LYNX 470 in maintaining disk drives, SECTION 4 should be consulted each time an alignment or a troubleshooting procedure is performed.

- Section 4B provides procedures to check the integrity of the following: LYNX 470 LED's, LYNX 470 circuitry, and alignment diskettes.

- Section 4C is a chart listing the major malfunctions encountered by drives, the most probable causes of these troubles and reference to the problem-solving procedures.

- Section 4D is comprised of detailed alignment and troubleshooting procedures in flowchart form and the LYNX 470 LED displays specific to each procedure.

- Section 4E - Test Point Guide - should be used when connecting the LYNX 470 to the drive under test.

- Section 4F is a collection of actual field service reports illustrating the diversity of troubles that are solved by an alignment procedure.

4B.1 INTRODUCTION

Prior to using the LYNX 470, it is necessary to test the LED's to verify that they are working (4B.2). Following the LED check, the LYNX 470 circuitry should be tested (4B.3). As well, the alignment diskette should be validated (4B.4). The locations of the track patterns on standard alignment diskettes are as follows:

Track Patterns	5 1/4" Drives-48tpi	96tpi	100 tpi	8" Drives
Amplitude	Track Ø	Ø	Ø	Ø
Sector/Index to Burst	1	2	5,76	1,76
Radial	16	32	36	38

Be sure to check manufacturer specifications for variations.

4B.2 LYNX 470 LED INTEGRITY TESTING

This brief check uses the "TEST" option of the POWER switch on the control panel of the LYNX 470. Setting the POWER switch to "TEST", observe that all the LED's on the LYNX 470 light. The switch will reset itself to "ON".

4B.3 LYNX 470 CIRCUITRY INTEGRITY TESTING

This testing procedure is to be performed with an 8" floppy diskette drive* and Dysan alignment diskette.

In preparation for the procedure:

- Set the following switches to the "OFF" or down position:

  DRIVE SELECT
  HEAD LOAD
  ENABLE
  STEP
  SEEK TRACK Ø
  TRACK ADDRESS SELECT
  POWER
  DATA
  WRITE

- Set the following switches as indicated:

HEAD SELECT	"0"
LOAD RADIAL	"Rd"
SPEED	"360"
SYNC	"Ex"
INDEX	"+"
AMP INPUT	"Std"

- Connect the 10-pin alignment cable (Figure 8) and the 50-pin exerciser cable (Figure 5).

- Load the alignment diskette into the drive.

* NOTE: This procedure can be adapted for use with a 5 1/4" disk drive by making changes where appropriate. For example, the maximum address possible would be different from an 8" drive, TRK 16 would be accessed instead of TRK 38, etc.

PROCEDURE

•Set POWER to "ON". If the POWER LED lights green, continue. If it lights red, check that the circuit breaker (Figure 1A) is pushed in.

•At DRIVE SELECT, select 1, 2, 3 or 4. (Set to "ON")

•Set ENABLE to "ON".

•Set STEP to "FAST".
The SEEK TRK Ø LED should light.

•At TRACK ADDRESS SELECT, set "1" to "ON". After the drive has stepped out and stopped, set the next highest address to "ON".
When switches 1 thru 32 are at "ON", the corresponding LED's should be lit.
Observe the movement of the read/write head.

•At DRIVE SELECT, deselect the drive (set to "OFF").
This should unload the head.

•At TRACK ADDRESS SELECT, set the two remaining switches (64, 128) to "ON".
All address LED's should be lit. The drive should not step because it is deselected.

•At TRACK ADDRESS SELECT, set "64" and "128" to "OFF".
The lighted LED's should indicate TRK 63.

•At DRIVE SELECT, reselect the drive.

•At TRACK ADDRESS SELECT, sequentially set all address switches from TRK 32 to "OFF". The address LED's should all go off. The SEEK TRK Ø LED should light and the TRK Ø LED on the display panel should light.

- Set SEEK TRK Ø to "ON"

- At TRACK ADDRESS SELECT, select various addresses. The drive should step at a fast rate between TRK Ø and the selected address.

- While the drive is stepping, toggle each of the following individually: ENABLE, POWER, STEP (from OFF to SLOW to OFF). In each case, toggling the switch should disable the stepping function.

- Toggle STEP (from SLOW to FAST to SLOW). The stepping rate should change.

- Set SEEK TRK Ø to "OFF". The drive should step to the selected address and remain there.

- Toggle POWER to "OFF" and then back to "ON". When set back to "ON", the head should step out a short distance, then back to TRK Ø and then to the address selected at TRACK ADDRESS SELECT.

- Step to TRK 38. Observe the following:

    - At RADIAL, one of the directional LED's (↱↰) should light. If the drive is perfectly aligned, both directional LED's will light alternately. The threshold (◯) and zero crossing (▽) LED's should stay off.

    - At AMPLITUDE, the LED's should flicker for varying durations. The lower numbered LED's should appear to stay on slightly longer than the higher numbered LED's.

    - At INDEX, the "+" INDEX LED and the "1.2/2.2" LED should both light. If not, the INDEX potentiometer may be out of adjustment.

- Step to TRK 39 and observe:
  - At RADIAL, the clockwise ( ) LED and the threshold ( ) LED should light.
  - At AMPLITUDE, all the LED's should flicker for approximately the same duration.

- Step to TRK Ø and observe:
  - TRK Ø and SEEK TRK Ø should light.
  - At RADIAL, the directional ( ) LED's should light alternately. The zero crossing ( ) LED should light.
  - At AMPLITUDE, all LED's should stay lit.
  - At SECTOR, all LED's should stay lit.
  - At INDEX, the "1.2/2.2" and "+" INDEX LED's should light.

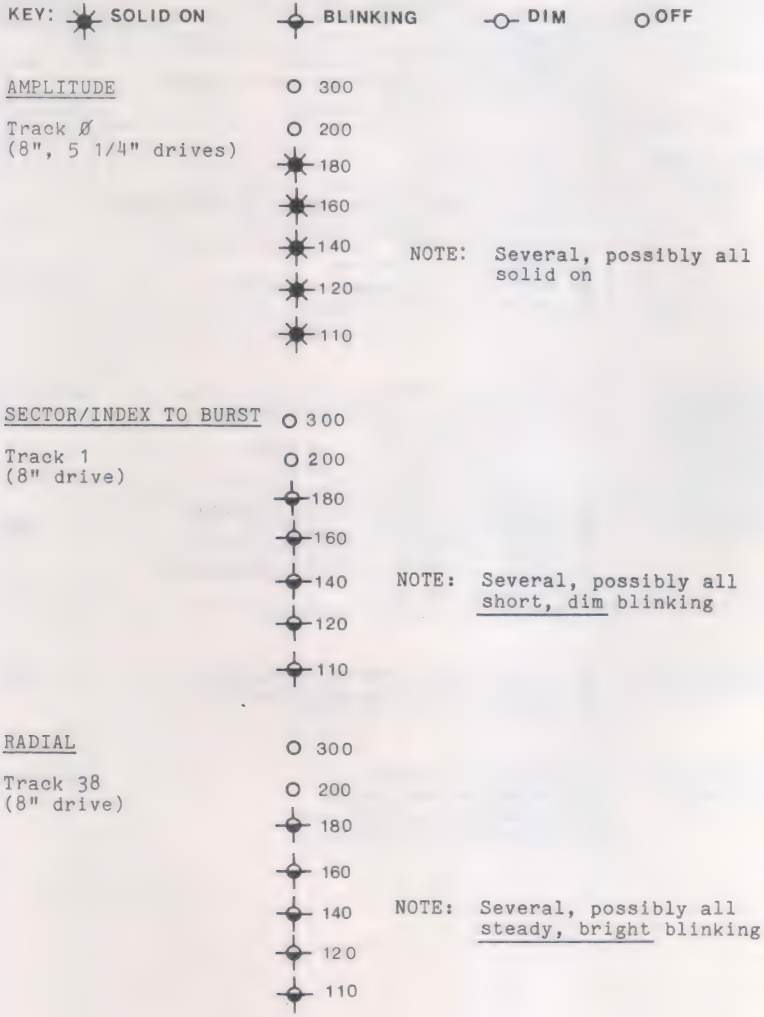
4B.4 ALIGNMENT DISKETTE INTEGRITY TESTING

The LYNX 470 unit is designed to operate in conjuction with the standard alignment diskette recommended by major manufacturers as follows:

Drive Type	Alignment Diskette	Lynx Alignment Diskette Part Number
5 1/4"	Single Side	AD-51
5 1/4"	Double Side	AD-52
8"	Single Side	AD-81
8"	Double Side	AD-82

Load the alignment diskette and step to the track indicated for Amplitude, Sector/Index to Burst and Radial tests (see 4B.1).

Basically, to verify that the alignment diskette is operational, check that the amplitude LED's on the LYNX 470 light when the specified tracks are accessed. The following LED displays should be observed:



If the LED's light, then the patterns are intact. If the LED's do not light (and the procedure in 4B.2 has been performed), load another alignment diskette and repeat the process.

TROUBLE INDICATOR	PROBABLE CAUSE(S)	PROCEDURE
4C.1 DISKETTE NOT ROTATING	a) seized motor b) belt broken or slipping c) diskette warped/improperly loaded d) bearing seized	GP1
4C.2 READ SIGNAL MISSING	a) head dirty b) head load pad dirty/worn c) double-sided drive-one defective head d) defective head and/or wires e) defective PCB - amplifier section f) defective diskette g) defective alignment diskette h) drive out of alignment	TS1
4C.3 DRIVE NOT RESPONDING TO COMMANDS/ HEAD NOT STEPPING/ HEAD STEPPING IN WRONG DIRECTION	a) defective cable b) non-standard ANSI connection c) write switch on d) track address not selected e) defective stepper motor f) defective controller g) defective index sensor assembly h) diskette loaded improperly i) drive optioned improperly j) cable to 470 attached improperly k) no power to 470 l) incorrect switch settings	TS2
4C.4 INDEX PULSE MISSING	a) index sensor assembly defective b) index sensor circuitry defective c) drive out of alignment	TS3
4C.5 NO TRACK Ø INDICATOR	a) defective sensor b) defective controller c) sensor out of alignment d) drive out of alignment	AL1.1-AL1.6

TROUBLESHOOTING - PROCEDURE GUIDE CONTINUED

TROUBLE INDICATOR	PROBABLE CAUSE(S)	PROCEDURE
4C.6 HEAD NOT LOADING	a) options on drive improper b) index missing (see 4C.4) c) defective solenoid d) defective controller e) 470 switch not selected	TS4
4C.7 WRITE ERRORS	a) drive out of alignment b) defective head c) defective controller	AL1.1-AL1.6
4C.8 WRITE PROTECT INOPERATIVE	a) defective sensor b) defective controller	See Service Manual
4C.9 READ ERRORS	a) R/W head dirty b) drive out of alignment c) Track Ø sensor out of alignment d) incorrect Track Ø alignment e) defective circuitry	AL1.1-AL1.6

4D ALIGNMENT/TROUBLESHOOTING PROCEDURES

4D.1 GENERAL NOTES
4D.2 AZIMUTH

GP GENERAL PROCEDURES

GP1 LYNX 470-INITIAL SET-UP

TS TROUBLESHOOTING PROCEDURES

TS1 READ/WRITE TEST
TS2 DRIVE NOT RESPONDING TO COMMANDS/HEAD NOT STEPPING
TS3 INDEX PULSE MISSING
TS4 HEAD NOT LOADING

AL ALIGNMENT PROCEDURES

AL1.1 POSITIVE ("+") INDEX STATUS
1.2 RADIAL ADJUSTMENT
1.3 HEAD AMPLITUDE - TRACK Ø
1.4 TRACK Ø ALIGNMENT
1.5 SECTOR/INDEX-TO-BURST ADJUSTMENT
1.6 HEAD SKEW CHECK
1.7 HEAD LOAD BOUNCE/HEAD LOAD SCAN (OPTIONAL)

4D.1 GENERAL NOTES

- In the following flowcharts, service manual refers to the drive manufacturer's manual. When referred to the service manual, it is either to verify specifications of the drive under test or to follow repair procedures for mechanical malfunctions.

- GP1 should be performed prior to any TS or AL procedures.

- The Alignment procedures-AL1.1 to AL1.6 are performed as a unit except where indicated otherwise. AL1.7 is optional, to be performed as required.

- When performing each procedure, observe the LED's specific to the test only. The exception is the Positive (+) Index indicator which is valid during all procedures except HEAD LOAD.

- The LED's are GREEN, AMBER or RED to provide instantly recognizable feedback during testing. Consistent with their standard functional intent (e.g. traffic signals), GREEN indicates an acceptable (proceed) test result, AMBER indicates a borderline reading (caution) and RED denotes that an unacceptable (stop) condition exists.

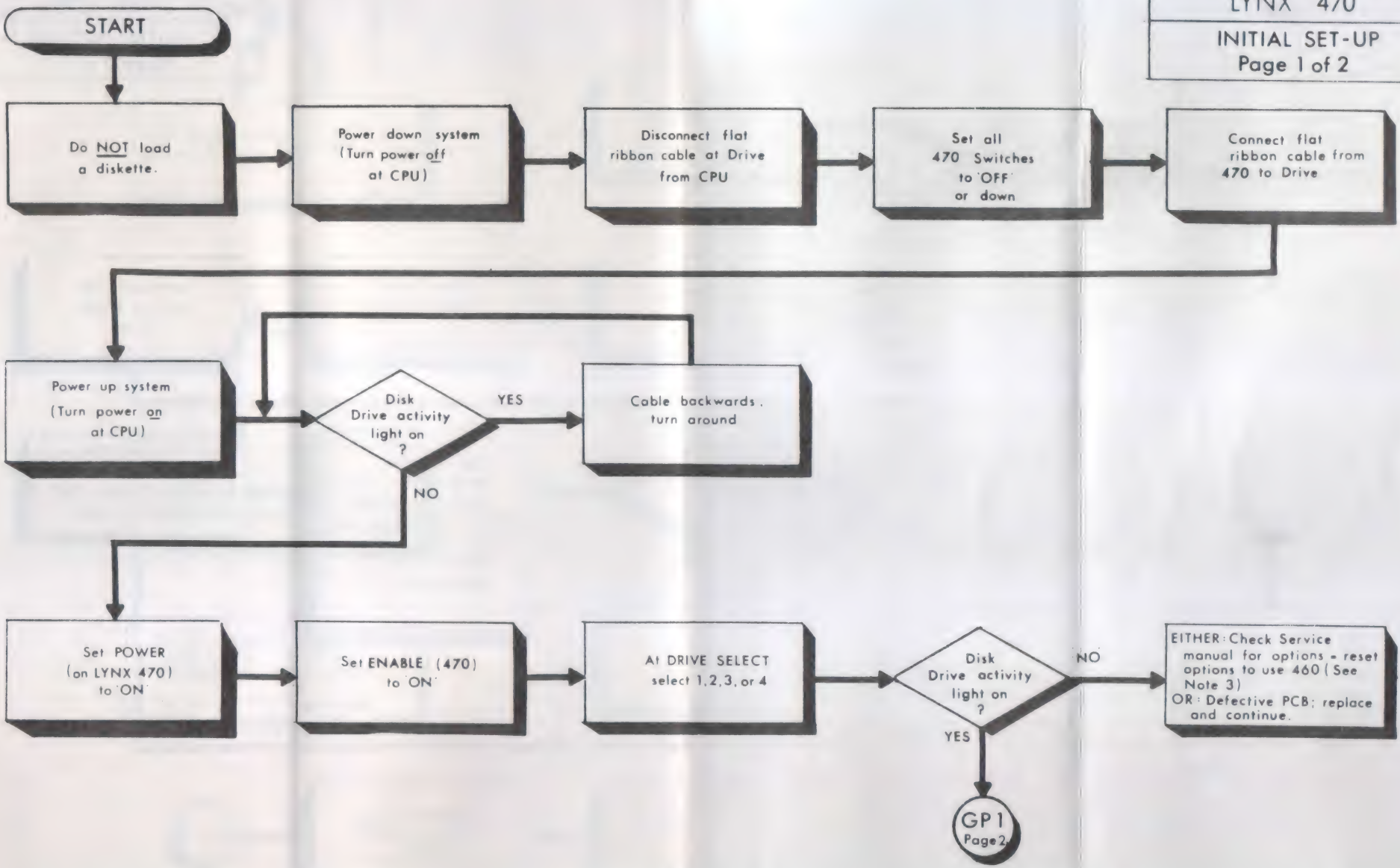
4D.2 AZIMUTH

Azimuth is generally defined as the angle of the R/W head relative to the written media. Azimuth is measured in minutes of a degree.

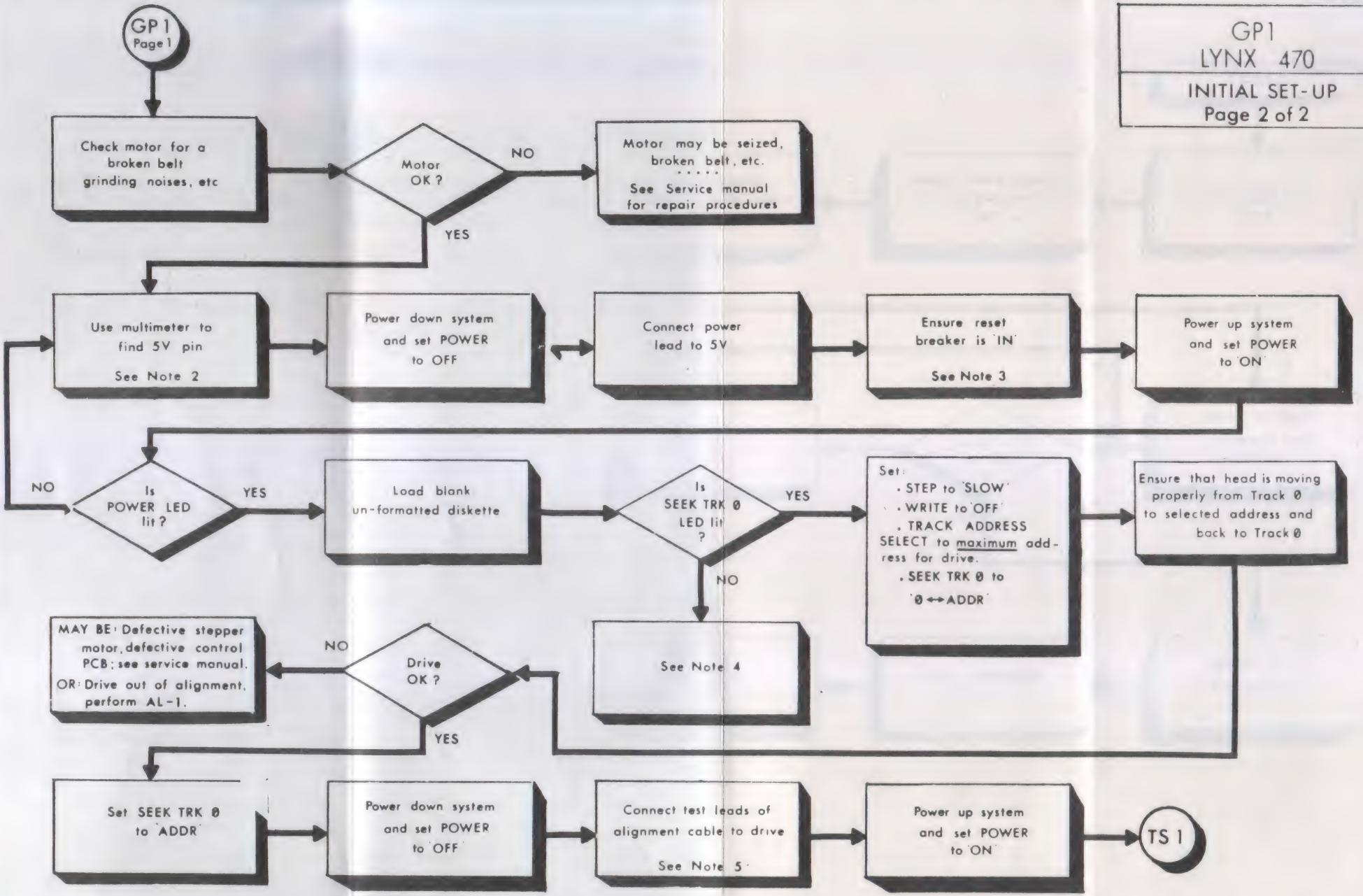
Since this adjustment is not normally recommended by manufacturers, the LYNX 470 has no specific means of checking or aligning the azimuth angle. However, the 470 allows parameters for default testing. If the drive under test passes all sections of the Alignment procedure and errors persist, a reasonable assumption is that the azimuth angle is beyond specifications. In such an event, the drive must be replaced.

GP 1
LYNX 470

INITIAL SET-UP
Page 1 of 2



NOTE 1: Following disconnection from LYNX 470, reset drive options according to local procedure.



NOTE 2: 5V is usually found near the bypass capacitors mounted close to the DC power Connector. See Figure 7 .

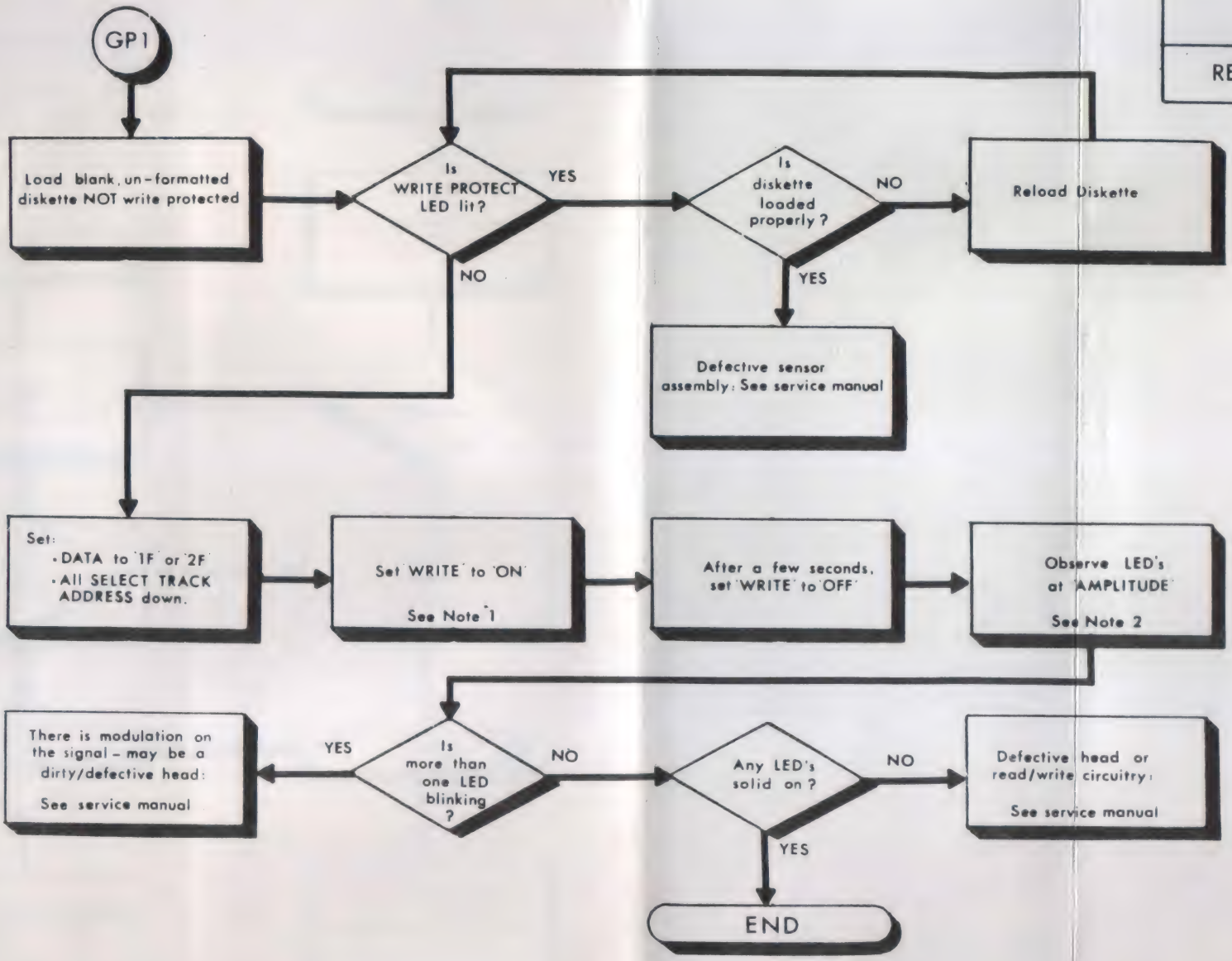
NOTE 3: At power, the LED should be green; if it is red, the reset breaker is "out" See Figure 1A.

NOTE 4: HEAD LOAD test lead may require connection. See service manual.

NOTE 5: Refer to Fig. 8 in Section 4E for test lead connections. Do not connect grey or black leads.

TS1

READ/WRITE TEST

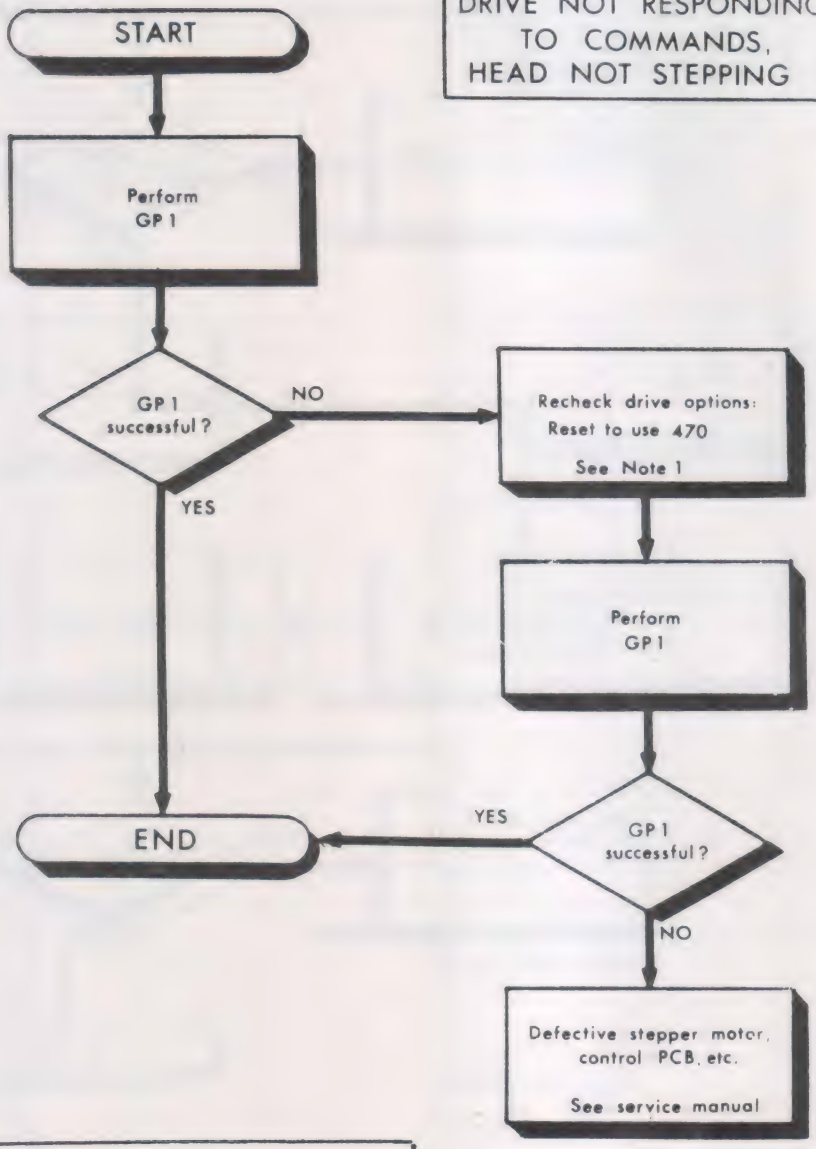


NOTE 1: LED's at AMPLITUDE will be OFF during a write operation.

NOTE 2: Most drives will provide amplitude sufficient to make all 7 LED's solid on.

TS 2

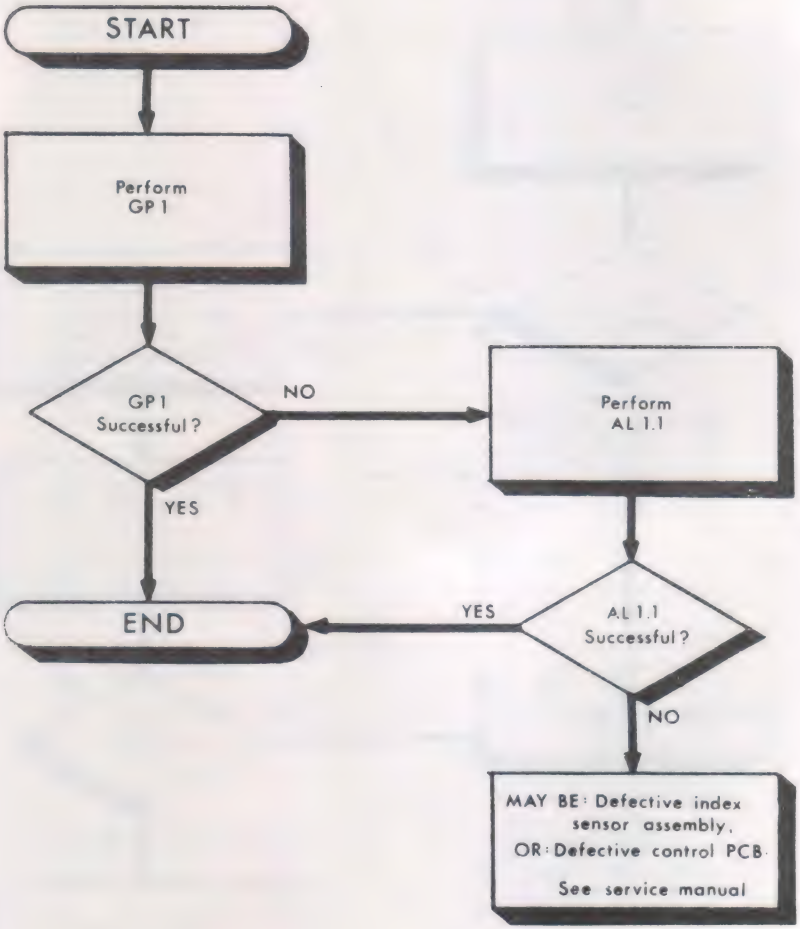
DRIVE NOT RESPONDING TO COMMANDS, HEAD NOT STEPPING



NOTE 1: Following disconnection from LYNX 470, reset drive options according to local procedure.

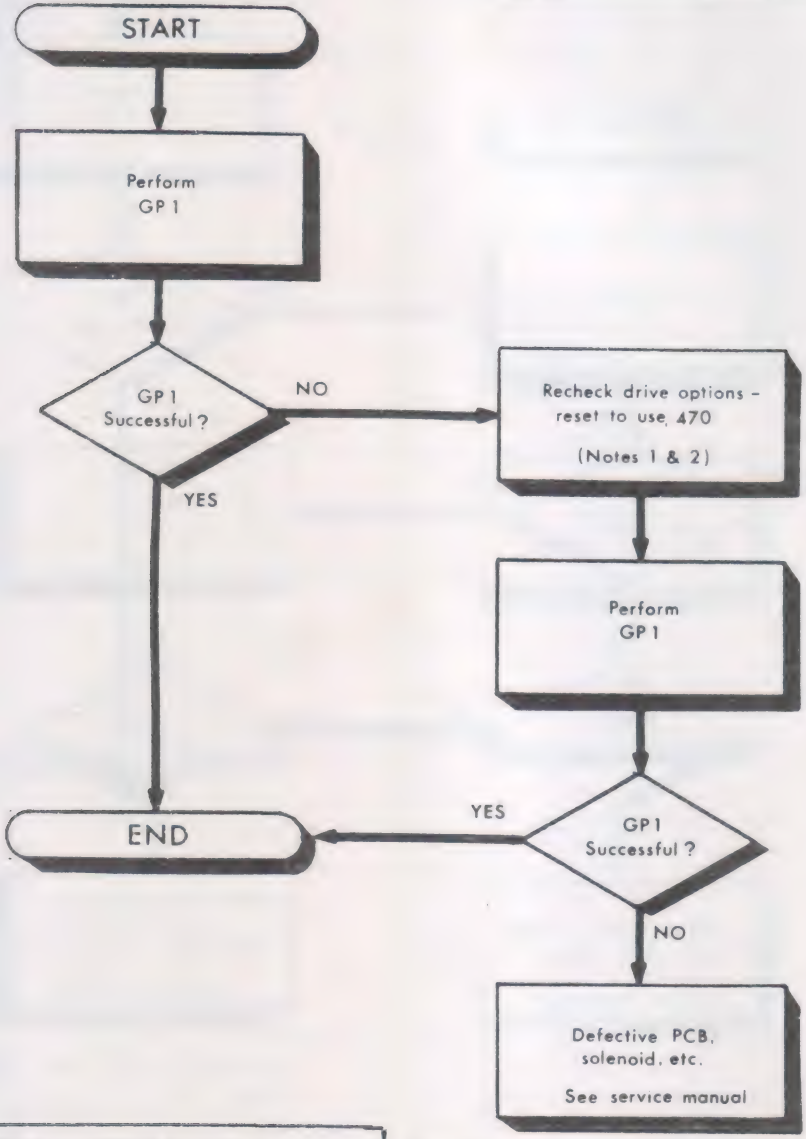
TS 3

INDEX PULSE MISSING



TS 4

HEAD NOT LOADING



NOTE 1: Following disconnection from LYNX 470, reset drive options according to local procedure.

NOTE 2: HEAD LOAD jumper must be installed to load head for some drives.

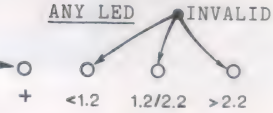
AL 1.1
POSITIVE INDEX
STATUS - LED's
8" DRIVES

8" DRIVES

KEY:
- SOLID ON
- BLINKING
- DIM
- OFF

Index pulse within specified window. Does not require adjustment.

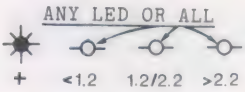
Index not detected.
See flowchart AL 1.1



Index less than 1.2 ms.
See flowchart AL 1.1

Index greater than 1.2 to 2ms
See flowchart AL 1.1.
NOTE: This does not apply to 5 1/4" drives.

Rising or falling edge reversed.
Correct switch setting.



AL 1.1
POSITIVE INDEX
STATUS - LED's
5 1/4" DRIVES

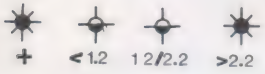
NOTE 5: There are no adjustments for 5 1/4" drives - if there are any "bad" readings the entire index sensor assembly must be replaced.

5 1/4" DRIVES

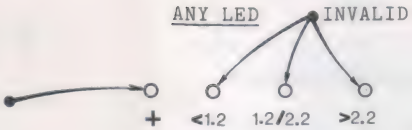
KEY:

- SOLID ON
- BLINKING
- DIM
- OFF

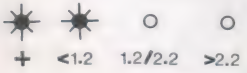
Index indicator correct. Drive does not require adjustment.



Index not detected. See NOTE 5

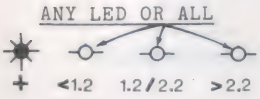


Index less than 1.2 ms. See NOTE 5



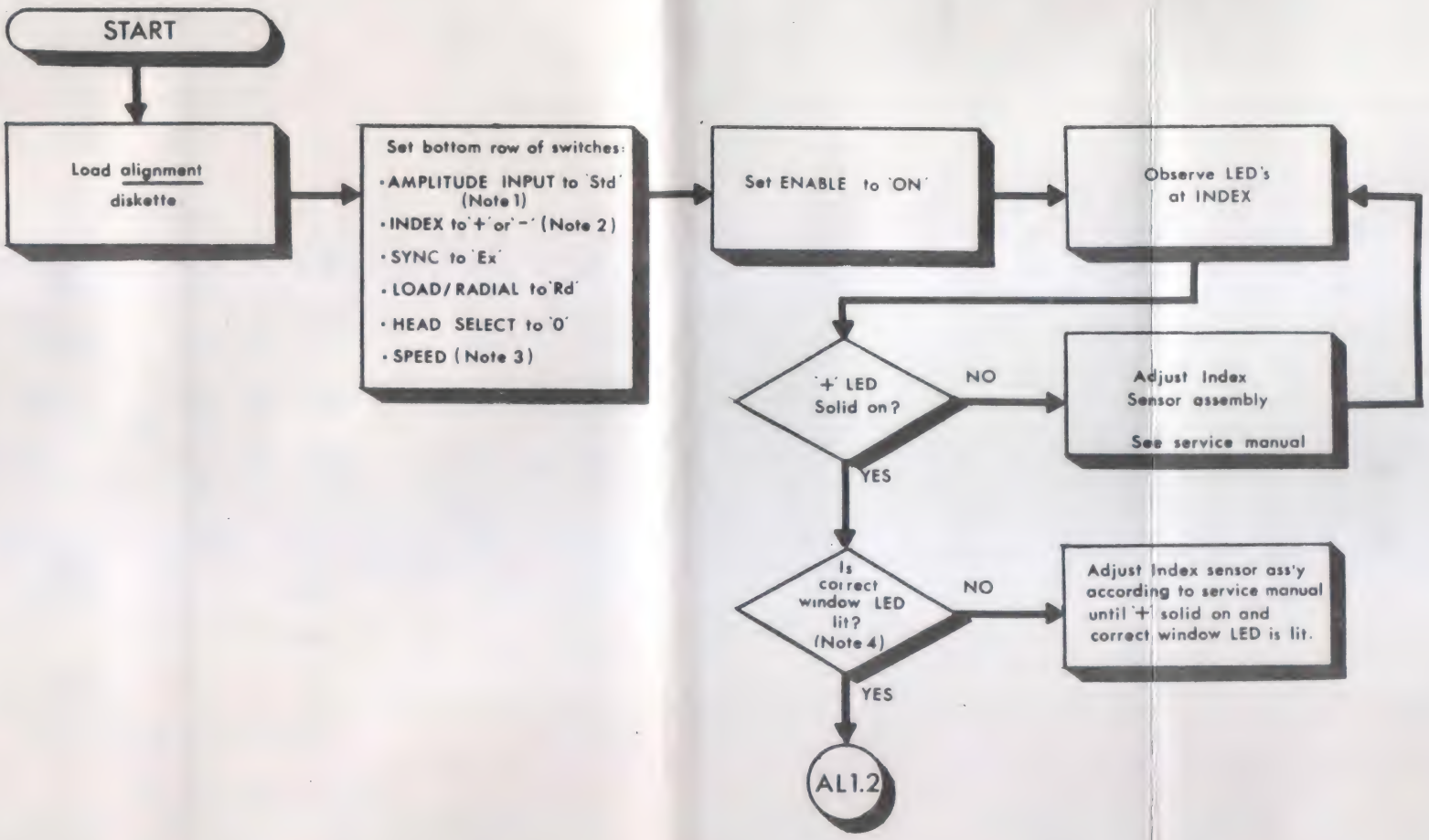
Index pulse not within specified window. See NOTE 5

Rising or falling edge reversed. Correct switch setting.



AL1.1

POSITIVE INDEX STATUS



NOTE 1: See Section 3B.96 for explanation of "Std" and "Amp" settings.

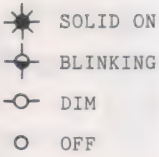
NOTE 2: "+" is rising edge; "-" is falling edge; most 8" drives require "+"; most 5 1/4" require "-". See service manual.

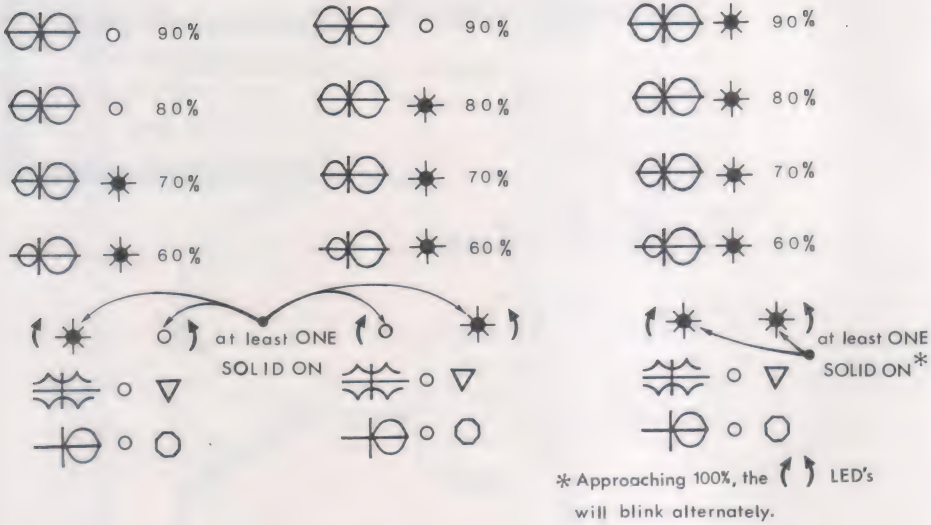
NOTE 3: Standard 8" drives require 360; 5 1/4" require 300. See service manual.

NOTE 4: Most 8" drives specify "2.2/1.2" as good; 5 1/4" - " 2.2". See service manual.

AL 1.2
RADIAL
ADJUSTMENT

KEY:

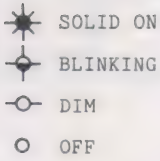




INDICATION OF 70% OR BETTER
NO ADJUSTMENT NECESSARY.

AL 1.2
RADIAL
ADJUSTMENT

KEY:

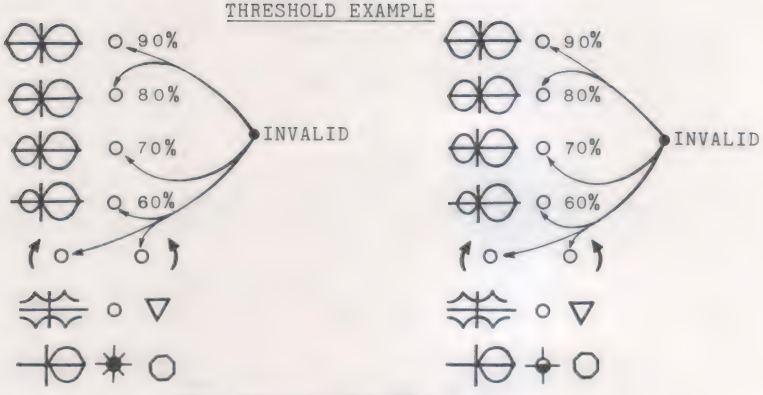


INDICATION OF LESS THAN 70%
RADIAL ADJUSTMENT NECESSARY

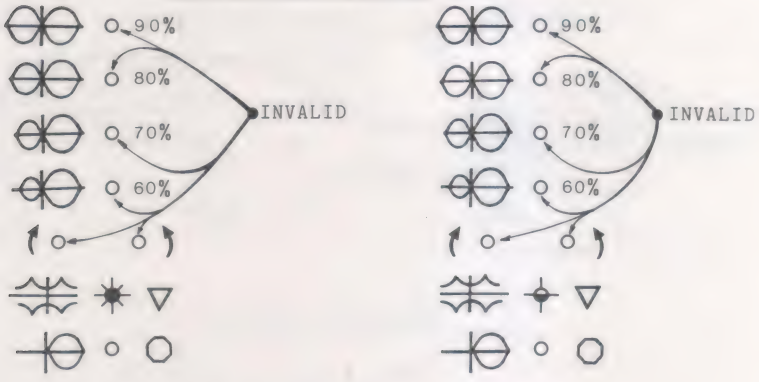
NOTE 2: The directional LED's (arrows) will indicate proper direction of rotation of the stepper motor depending on your proximity to the drive.

AL 1.2
RADIAL ADJUSTMENT
• THRESHOLD
• ZERO CROSSING

THRESHOLD EXAMPLE



ZERO CROSSING EXAMPLE

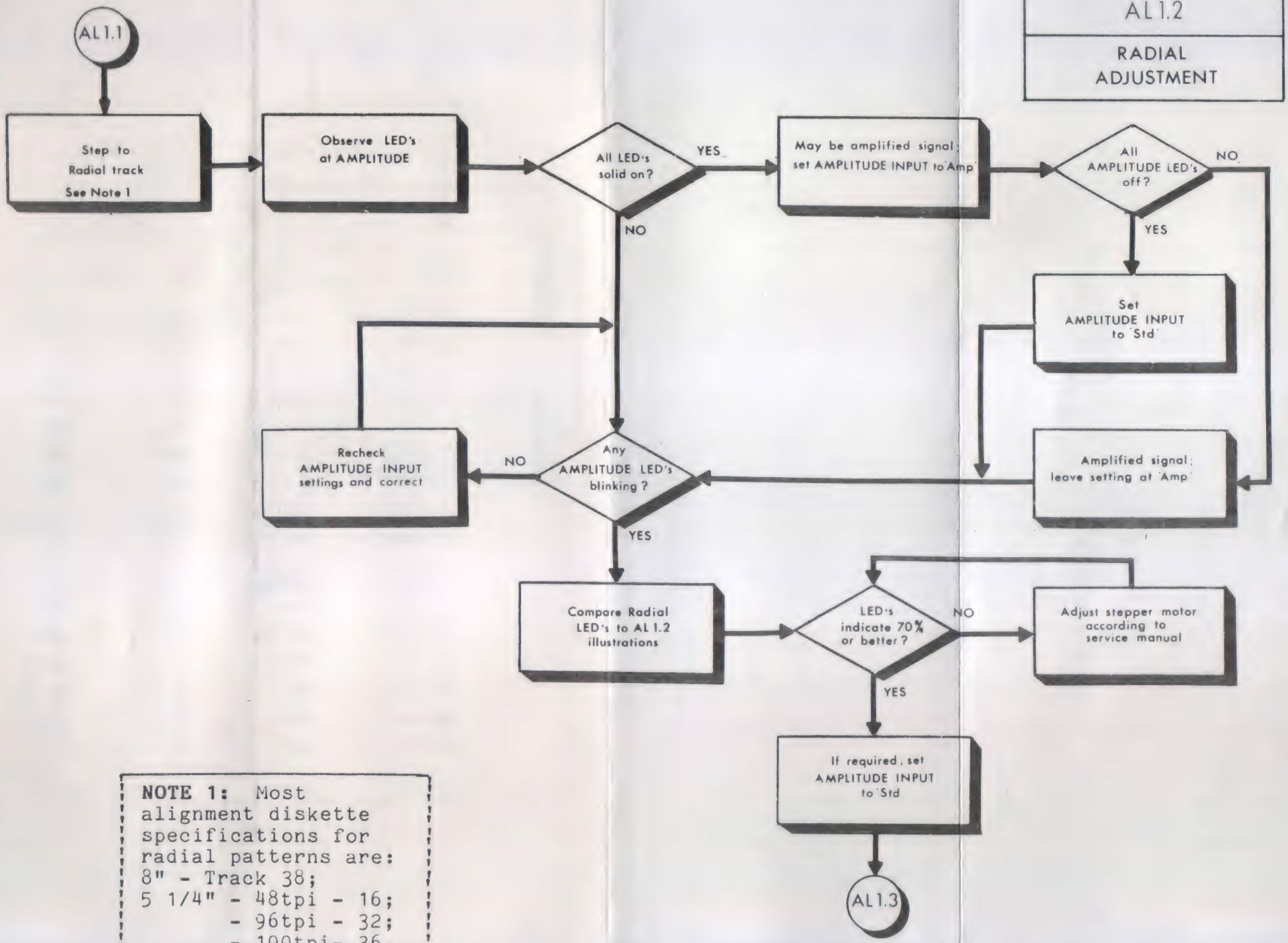


Either of these LED'S when lit indicates that a major adjustment of the drive is necessary to obtain proper specifications. ANY INDICATION OF DIRECTIONAL LED's OR % LED WHILE EITHER THE ◯ OR ▽ IS ON OR BLINKING IS INVALID.

NOTE 3: If BOTH threshold and zero crossing LED'S are on, the disk drive may be stepping to the wrong track. Verify that there is some amplitude during these tests.

AL1.2

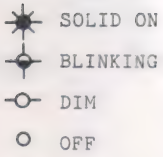
RADIAL ADJUSTMENT



NOTE 1: Most alignment diskette specifications for radial patterns are:
8" - Track 38;
5 1/4" - 48tpi - 16;
- 96tpi - 32;
- 100tpi- 36.

AL 1.3
HEAD AMPLITUDE
TRACK Ø

KEY:

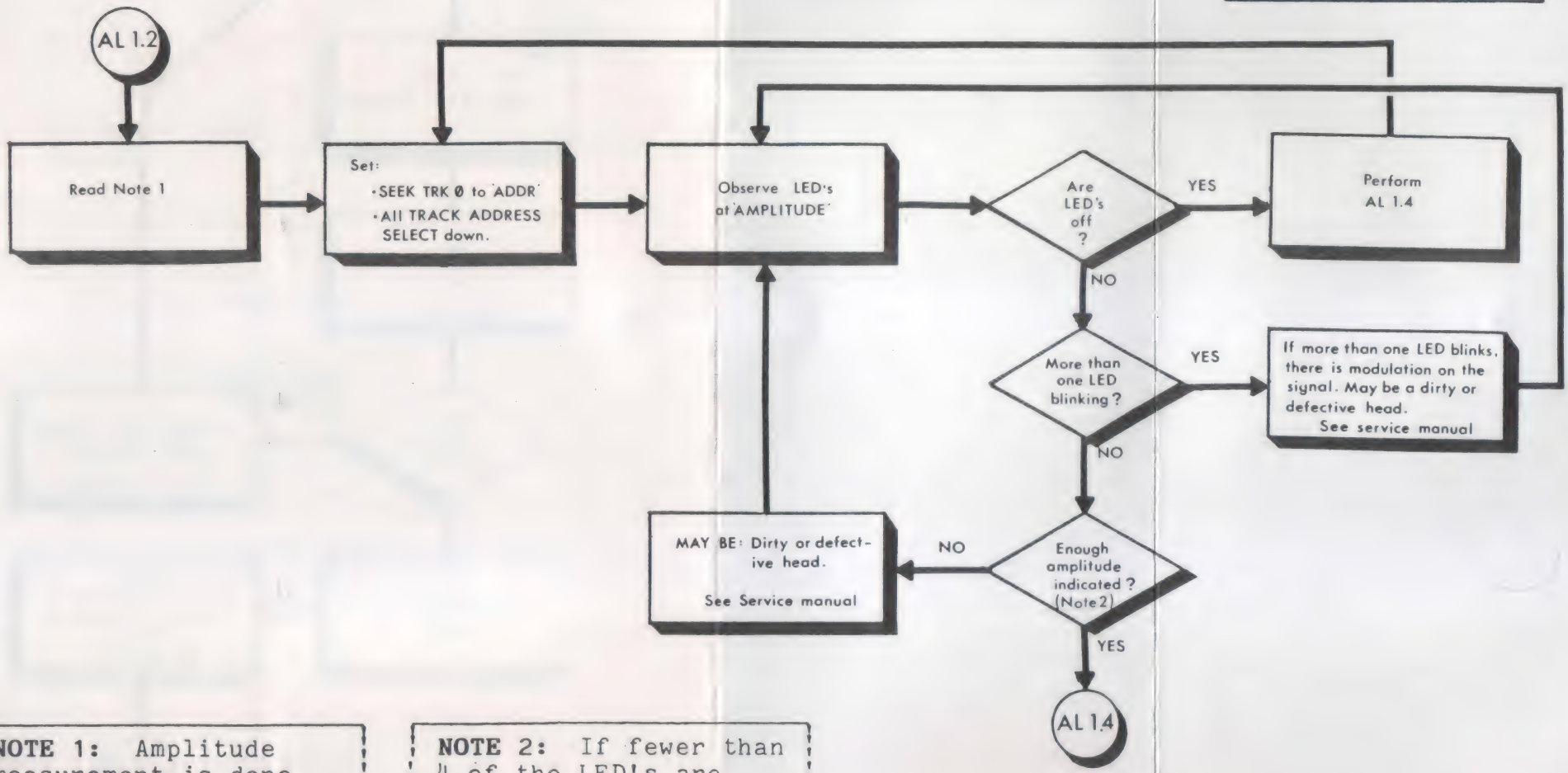


300	300	300	300
200	200	200	200
180	180	180	180
160	160	160	160
140	140	140	140
120	120	120	120
110	110	110	110
Amplitude less than 110 millivolts	Amplitude between 110mv & 120mv	Amplitude between 120mv & 140mv	Amplitude between 140mv & 160mv

300	300	300	300
200	200	200	200
180	180	180	180
160	160	160	160
140	140	140	140
120	120	120	120
110	110	110	110
Amplitude between 160mv & 180mv	Amplitude between 180mv & 200mv	Amplitude between 200mv & 300mv	Amplitude exceeds 300mv

AL 1.3

HEAD AMPLITUDE CHECK (TRACK Ø)

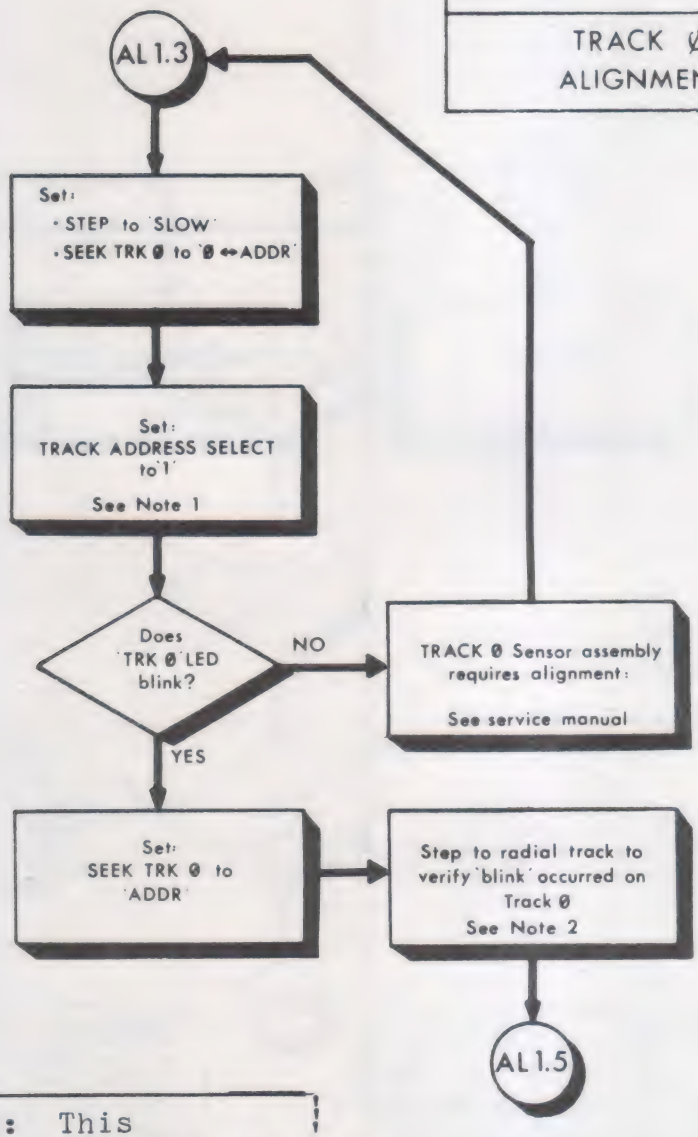


NOTE 1: Amplitude measurement is done with the prerecorded 1F pattern on the alignment diskette. All measurements are done and calibrated to give the same amplitude measurement as on an oscilloscope set for dual channel operation with one channel added and inverted.

NOTE 2: If fewer than 4 of the LED's are SOLID ON, check service manual for minimum peak-to-peak values for the drive under test.

AL1.4

TRACK Ø ALIGNMENT



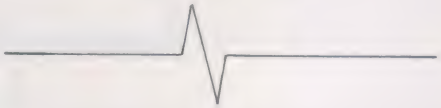
NOTE 1: This flowchart assumes the transition (LED blinks) occurs between Track Ø and 1. On some drives, it occurs between 1 and 2; on others between 2 and 3. See Section 4E.2 Test Point Guide-NOTES

NOTE 2: Most alignment diskette specifications for radial patterns are:
8" - Track 38;
5 1/4" - 48tpi - 16;
- 96tpi - 32;
- 100tpi- 36.

AL 1.5
SECTOR/INDEX
TO BURST
ADJUSTMENT

NOTE 2: Described and illustrated below are the different sector and/or index to burst patterns found on standard alignment diskettes.

FIGURE A:



SECTOR PULSE

FIGURE B:

SECTOR BURST

FIGURE C:

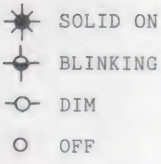
INDEX TO BURST
SECTOR BURST

FIGURE D:

INDEX TO BURST
SECTOR BURST

AL 1.5
SECTOR/INDEX
TO BURST
ADJUSTMENT

KEY:



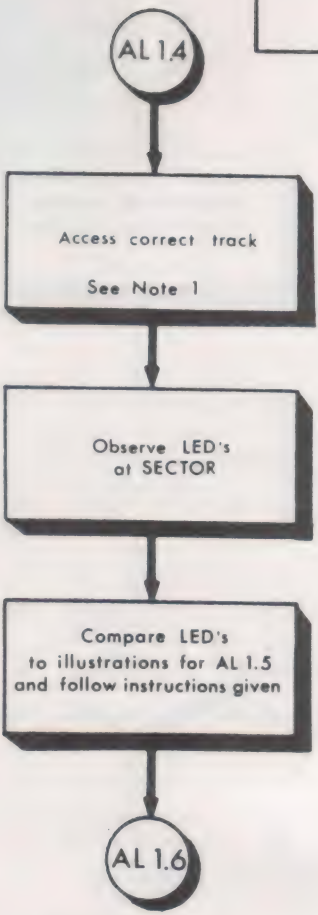
NOTE 3: Adjustment of this signal is made by a potentiometer, or by the movement of the LED sensor assembly. Adjust according to manufacturer's manual procedure, until the desired LED window is solid on. Note that varying this signal will also affect the INDEX signal. Care must be exercised so that both of the signals are within tolerance when adjusted. (See AL 1.1)

NOTE 4: Regardless of the pattern, measurement is taken at the LEADING EDGE. Various patterns will produce different trailing edges.

** OPTIMUM READING: LEADING EDGE OF BURST IS AT 200 μs EXACTLY.

AL 1.5

SECTOR/INDEX-TO-BURST ADJUSTMENT



NOTE 1: Alignment diskette specifications for Sector/Index-to-Burst patterns are:
8" - Tracks 1, 76
5 1/4" -"8tpi - 1,34
-96tpi - 2,68
-100tpi- 5,76
Use the lower numbered track for AL1.5; the inner track (higher number) is used for the head skew check (AL1.6).

AL 1.5
SECTOR/INDEX
TO BURST
ADJUSTMENT

Leading edge of burst less than 100 μs. Drive requires adjustment.

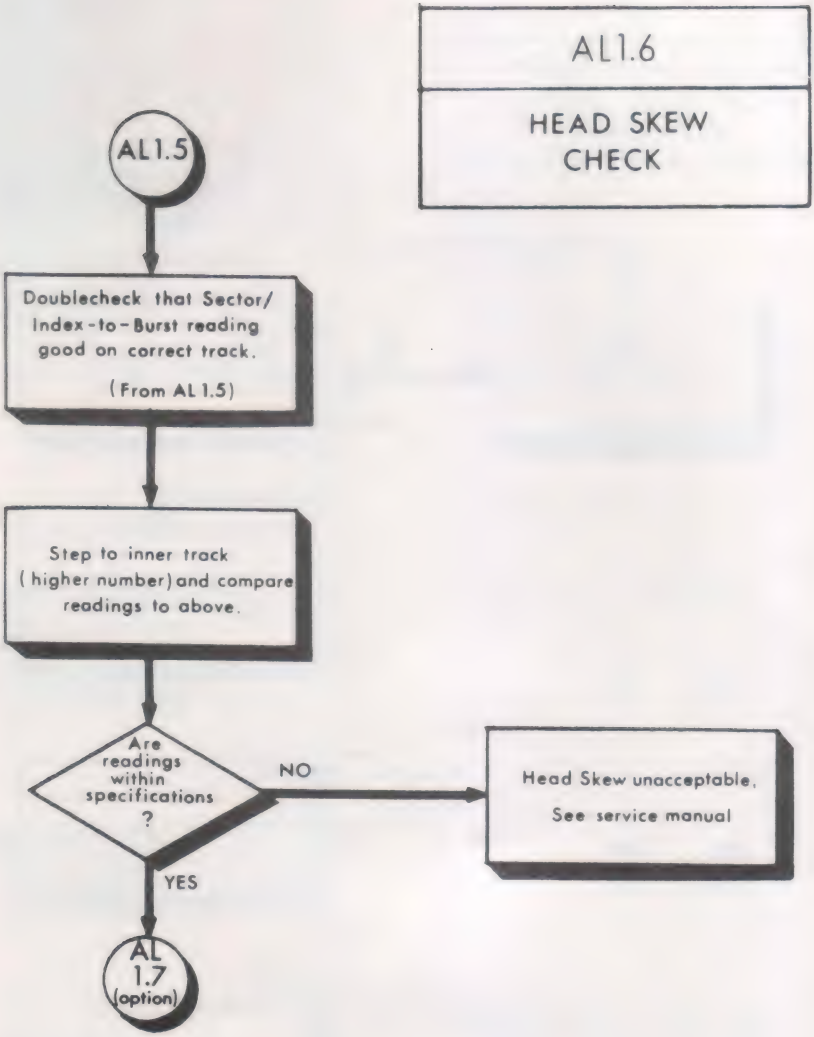
Leading edge of burst within 100/140 window.

Leading edge of burst within 140/200 window.

Leading edge of burst within 200/240 window.

Leading edge of burst within 240/300 window.

Leading edge of burst begins later than 300 μs. Drive requires adjustment.



NOTE 1: Alignment diskette specifications for Sector/Index-to-Burst patterns are:
8" - Tracks 1, 76
5 1/4" -48tpi - 1,34
-96tpi - 2,68
-100tpi- 5,76

AL 1.7
- HEAD LOAD BOUNCE
- HEAD LOAD SCAN

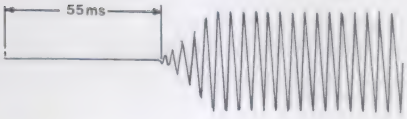
KEY:

SOLID ON
BLINKING
DIM
OFF

LYNX LED

HLB HLS

OSCILLOSCOPE PATTERN

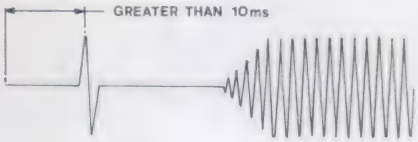


BOTH OFF
NO BOUNCE DETECTED

HLB HLS

BOUNCE DETECTED

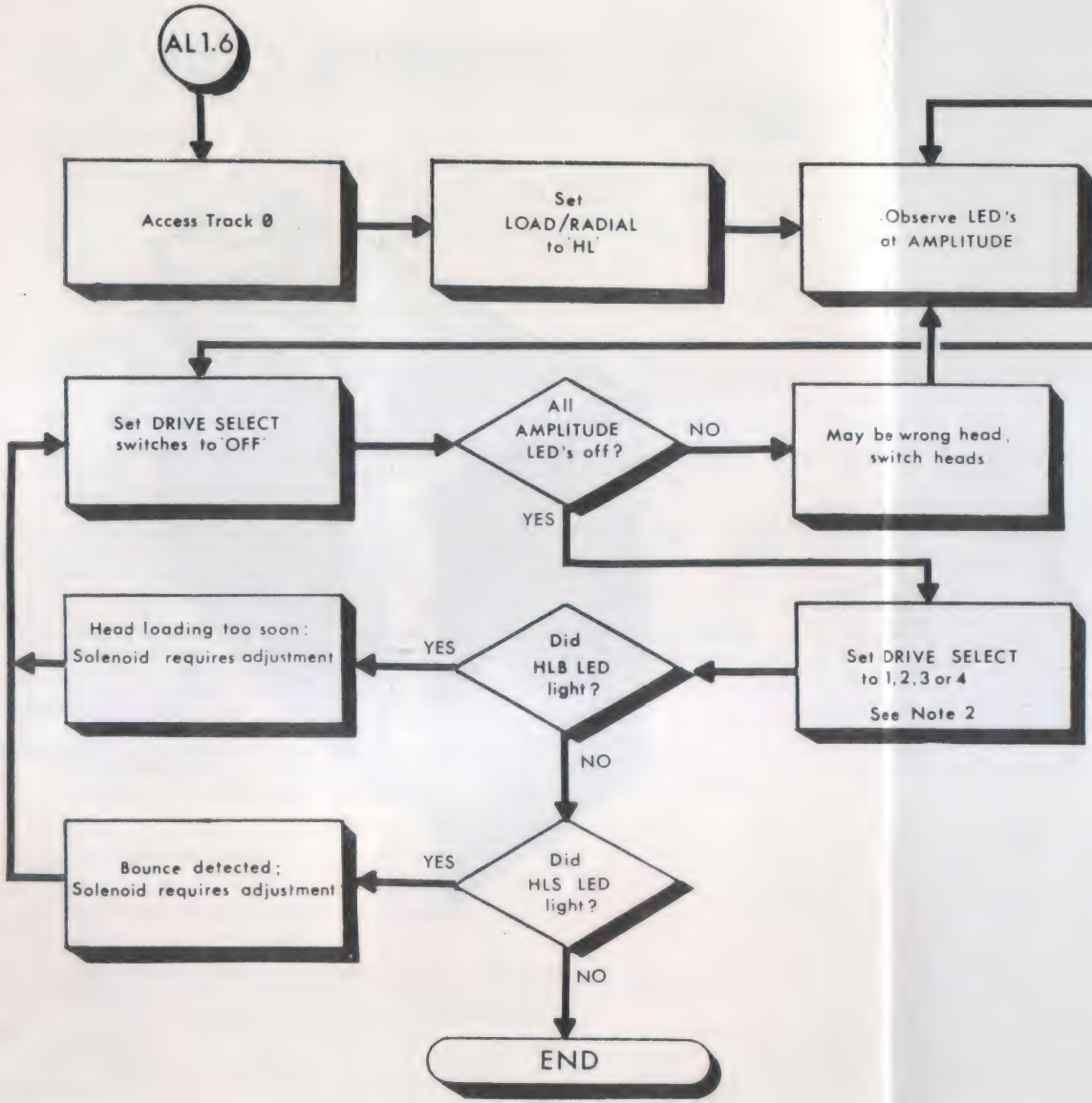
HLB HLS



BOUNCE DETECTED

AL 1.7

HEAD LOAD BOUNCE HEAD LOAD SCAN (OPTIONAL)

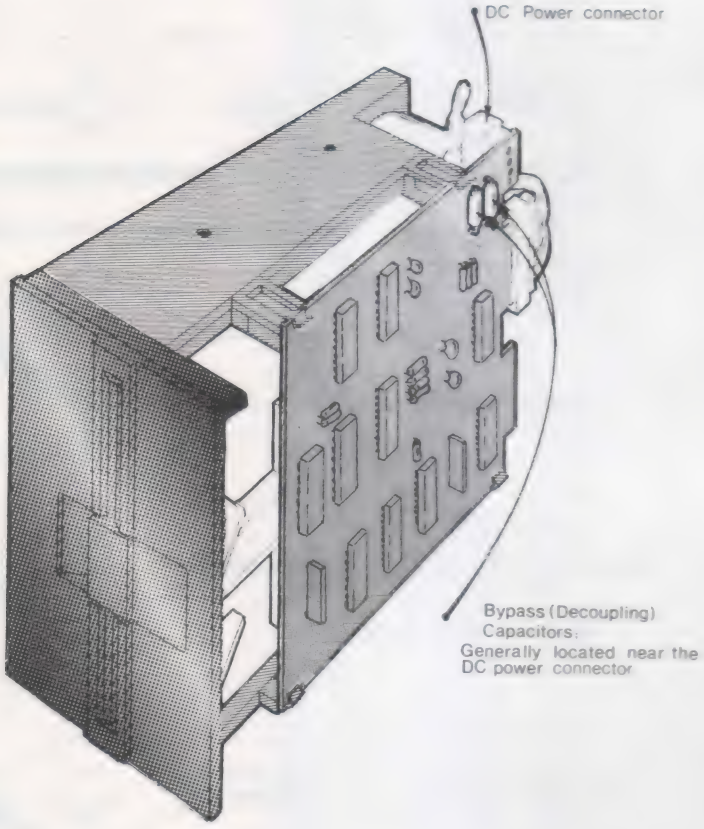


NOTE 1: Check service manual for minimum peak-to-peak values for the drive under test.

NOTE 2: Do NOT use the HEAD LOAD switch for this test -deselecting the drive clears the memory -HL does not.

Decoupling Capacitors

Figure 7



4E TEST POINT GUIDE

Section 4E.1 provides general information about the operation and connection of the LYNX 470 as well as Figure 8, illustrating the test leads of the Alignment Cable. Test points on common drives are organized into chart-form in 4E.2, while diagrams illustrating test points on some drives are found in 4E.3.

4E.1 Although operation and connection of the LYNX 470 is not difficult, we suggest when possible that initial users connect the unit in parallel with an oscilliscope to determine exact operational procedures and to familarize themselves with the use of the LYNX 470. To determine correct power and polarity connections, a voltmeter (or standard multimeter) must be used to prevent accidental tripping of the circuit breaker. Standard power can be found on bypass filter capacitors: See Figure 7.

Disk drives have test points for ease of connection for servicing. For proper use of the LYNX 470, the following must first be determined from the drive to be tested.

- Amplified or non amplified test points for the 1st and 2nd stage of the amplifier from the record head. If a scope has been used, these are the standard designation points for signal source. Set amplitude input.

- Index test point from which standard external source triggering is available. If not available switch unit to internal trigger mode for radial adjustments.

- Track Ø test point.

- Head load test point, if necessary.

- Side select (this is generally not available as a test point but rather as a customer jumperable option). Check your manual for further information.

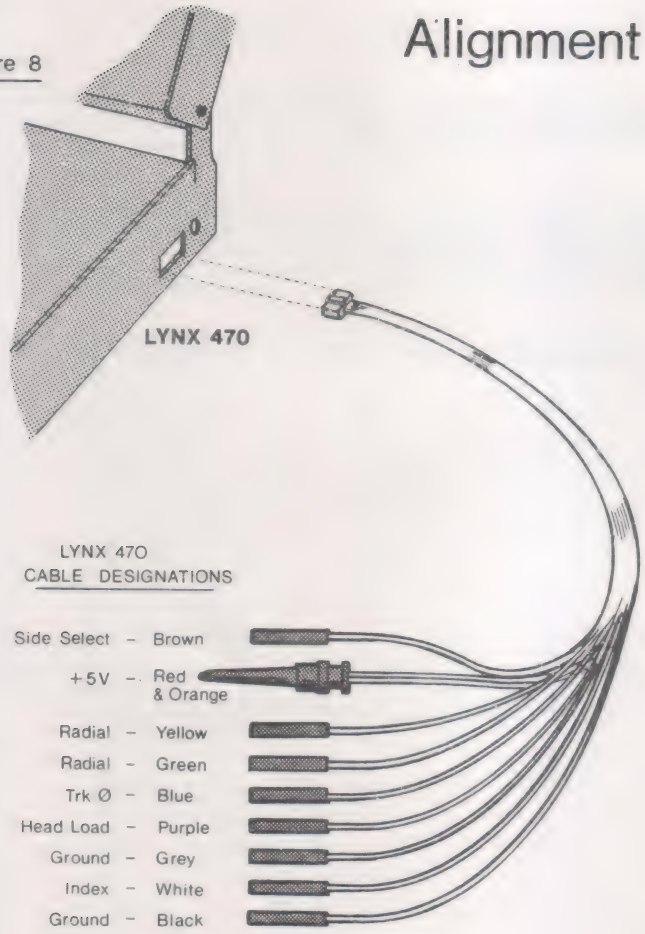
- Positive +5 volt source taken from the disk drive PCB under test. See Figure 7. To insure accurate measurememts, power must be taken from the PCB under test.

- Ground source may be taken from the PCB under test. However, since every other conductor in the flat ribbon cable is ground, as long as the flat ribbon cable is connected, ground is provided. Therefore, in most cases, DO NOT CONNECT the BLACK and GREY leads.

- Standard alignment diskette. Refer to Section 4B for exact models.

Alignment Cable

Figure 8



4E.2 Test Lead Guide

Disk Drive Manufacturer	HEAD AMP YEL	HEAD AMP GRN	INDEX WHT	TRK 00 BLU	HEAD LD. PUR
Apple: Disk II	8	9	internal sync	-	-
CalDisk: 142M	E	F	A	H	-
Canon: MDD210	3	4	IC10, pin 6 #	2	-
CDC:					
9404B	A	B	J1-20	J3-2	-
9406	3	4	14	J6-3	-
9408	1	2	J1-8	J3-18	-
9409	1	2	J1-8	J3-18	-
9409T	1	2	J1-8	J3-24	-
Hitachi: HFD305S	4	5	1	8	-
Memorex:					
550/552 **	1	2	45	12	-
651	1	2	10	-	-
Micropolis:					
1015/1016F	4	5	2	14	-
1115	TP11-5, TP11-1	TP11-6, TP11-2	TP8-2	*	-
Mitsubishi: M4851/4853	TPB9	TPB10	TPD14	TPE1	-
MPI:					
51/52	1	2	6	J4-12	-
91/92	ICF2-7	ICF2-8	6	J4-12	-
NEC:					
FD1160	23	24	5(6DS)	4	-
FD1165	8	9	10(7DS)	12	-
Osborne: Osborne I	7	8	5	4	-
Qume:					
142	1A	1B	7	8	-
542	1A	1B	3	5	-
842 **	1A	1B	3	J2,A11#	-
Remex: RFD 480, RFD 960	1	2	3	IC8A, pin 14#	-
Sharp: JK875	1	2	7	8	-

Disk Drive Manufacturer	HEAD AMP YEL	HEAD AMP GRN	INDEX WHT	TRK 00 BLU	HEAD LD. PUR
Shugart:					
SA200	1	2	7	8	-
SA300	1	2	7	8	-
SA400	1	2	7	8	-
SA450	1	2	7	8	-
SA410/460	1	2	7	16	-
SA800/801	1	2	12	26	-
SA850/851	1	2	12	26	11
SA810/860	1	2	12	26	-
Siemens:					
FDD200-5	1	2	5	8	-
FDD100-8 **	TPC2	-	TPA8	TPA4	-
Sykes Data:					
FD 700/900	1	-	6	5	-
Tandon:					
TM50-1	4	5	12	J9-4	-
TM100-1	1	2	7	8	-
TM100-2	1	2	7	J11-2	-
TM100-3,-4	1	2	7	J11-2	-
TM848-1	2	3	11	10	-
TM848-2	2	3	12	10	-
Teac:					
FD55	7	8	4	1	-
YE Data:					
G86-04	1A	1B	3	5	-

NOTES: TRK 0 transitions may occur between TRKS 0 & 1, TRKS 1 & 2, or TRKS 2 & 3. Further, different versions of the same manufacturer's disk drive may vary in this respect. Consult the service manual for the specific transition.

NOTES: * Use voltmeter to determine track 0 positioning.

** Index switch (+/-) must be in '-' position.

Device locations are dependent upon revision level of controller PCB, where information is taken. Lynx will not be responsible for error in placement. Please refer to manufacturers schematics.

- **For determining placement of Red test lead, use voltmeter to find proper +5V source.**

- Brown test lead is used on drive PCB's, where 'Side Select' line on main I/O port is cut. Refer to manufacturers OEM guide.

4E.3 Test Point Diagrams

Drive	Service Bulletin No.
Control Data 9409 (IBM PC)	CDTP 04
Hitachi HFD305S	H1TP 01
Memorex 550/552 (Long Board)	XTP 05
MPI 51/52	MPTP 01
Micropolis 1115	MTP 01
Osborne 1	OTP 01
QumeTrak 142	QTP 07
QumeTrak 542	QTP 09
QumeTrak 842	QTP 08
Shugart SA 200	STP 05
Shugart SA 300	STP 10
Shugart SA 400	STP 07
Shugart SA 450	STP 09
Shugart SA 455	STP 04
Shugart SA 800/801	STP 06
Shugart SA 850/851A	STP 08
Siemens FDD 200-5	SETP 01
Tandon TM 100-2 (IBM PC)	TTP 03
Tandon TM 848-1,848-2	TTP 02
Televideo / Mitsubishi 4851/4853	TVTP 01

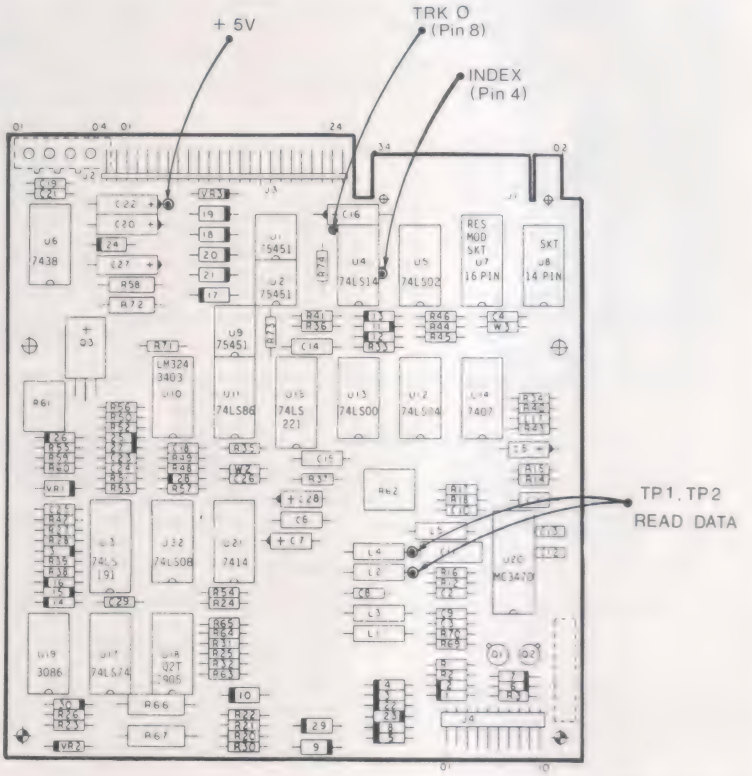
LYNX

SERVICE BULLETIN

BULLETIN No. CDTP-04

CONTROL DATA 9409 (BR881)

(IBM PC)

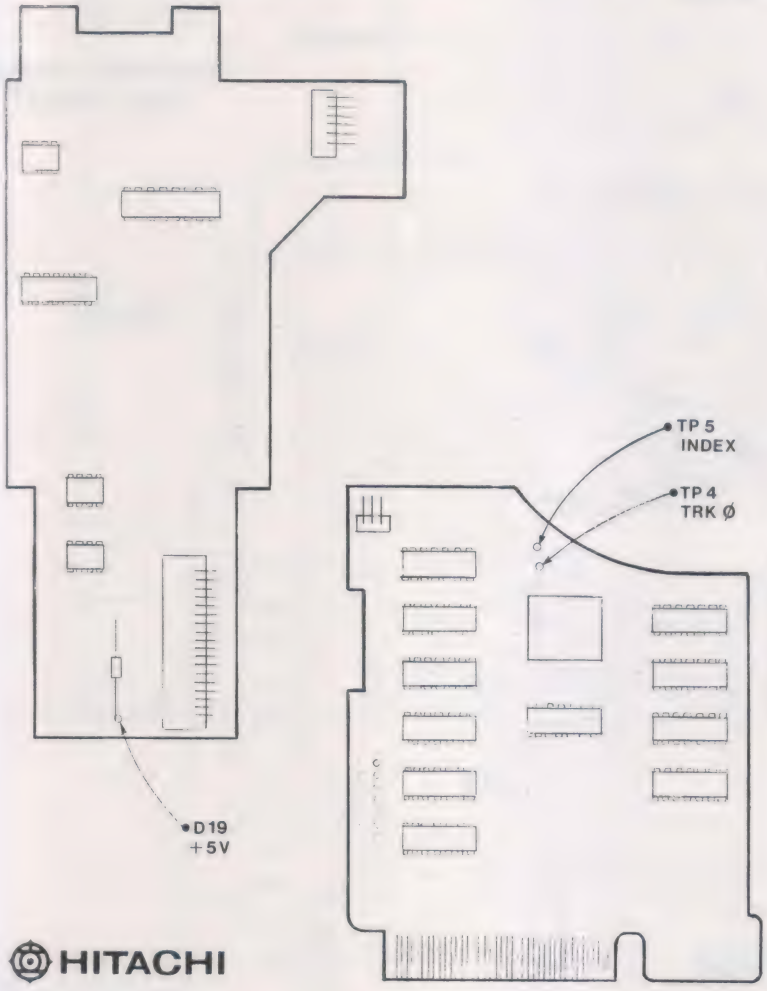


IBM
Personal Computer

SERVICE BULLETIN

HITACHI HFD 305S

BULLETIN No. HITP 01

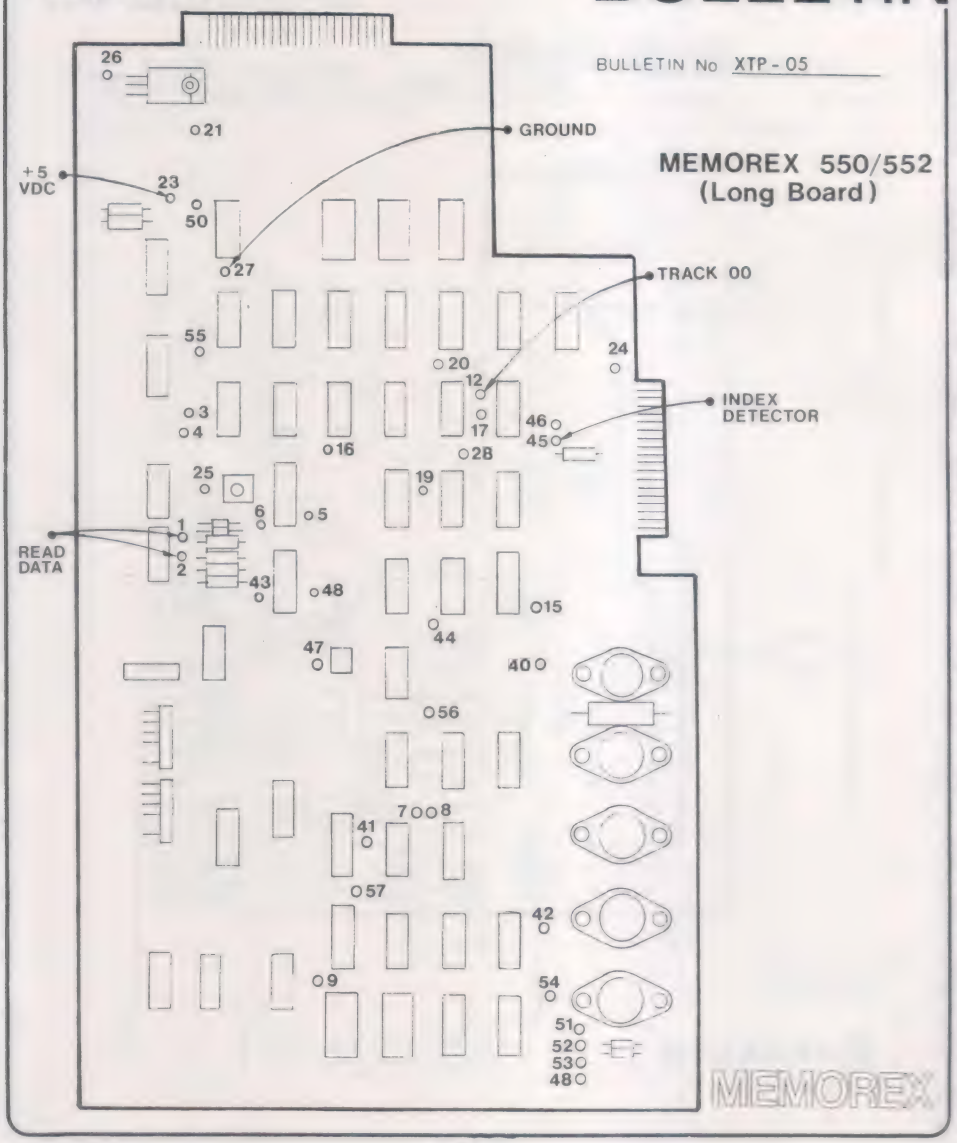


HITACHI

SERVICE BULLETIN

BULLETIN No XTP-05

MEMOREX 550/552 (Long Board)

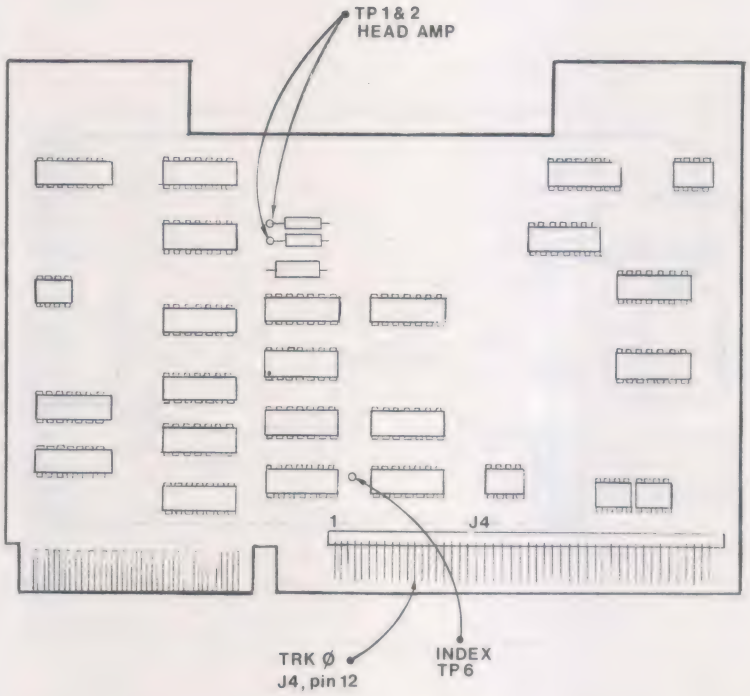


LYNX TECHNOLOGY INC

SERVICE BULLETIN

BULLETIN No. MPTP 01

MPI 51/52

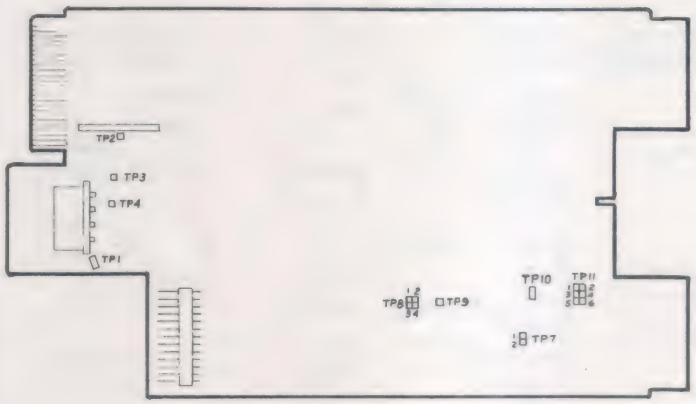


MPI

SERVICE BULLETIN

BULLETIN No MTP 01

MICROPOLIS 1115

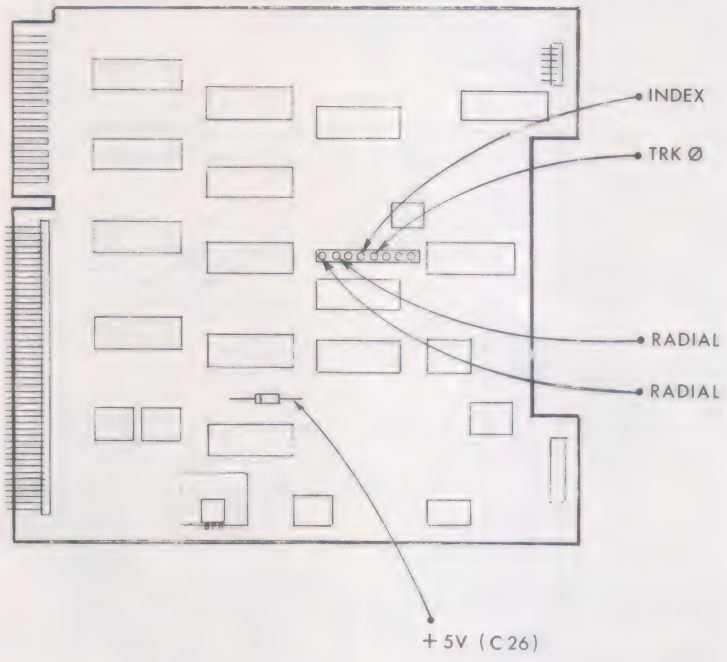


MICROPOLIS™

SERVICE BULLETIN

BULLETIN No OTP 01

OSBORNE 1

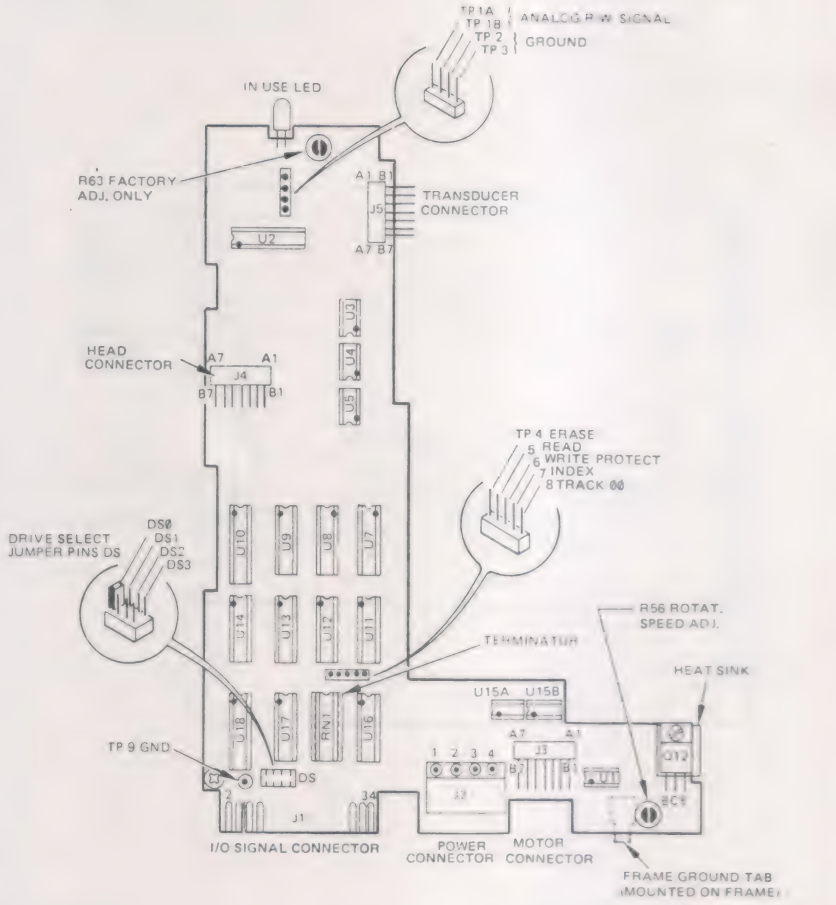


LYNX

SERVICE BULLETIN

QUMETRAK 142

BULLETIN No. QTP 07

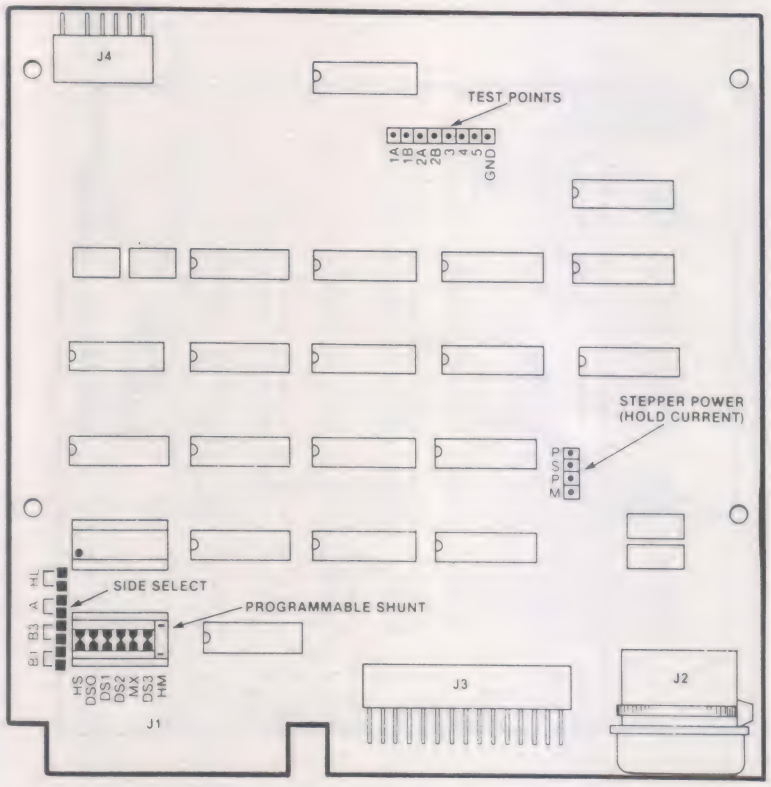


Qume
A Subsidiary of ITT

SERVICE BULLETIN

BULLETIN No QTP 09

QUMETRAK 542

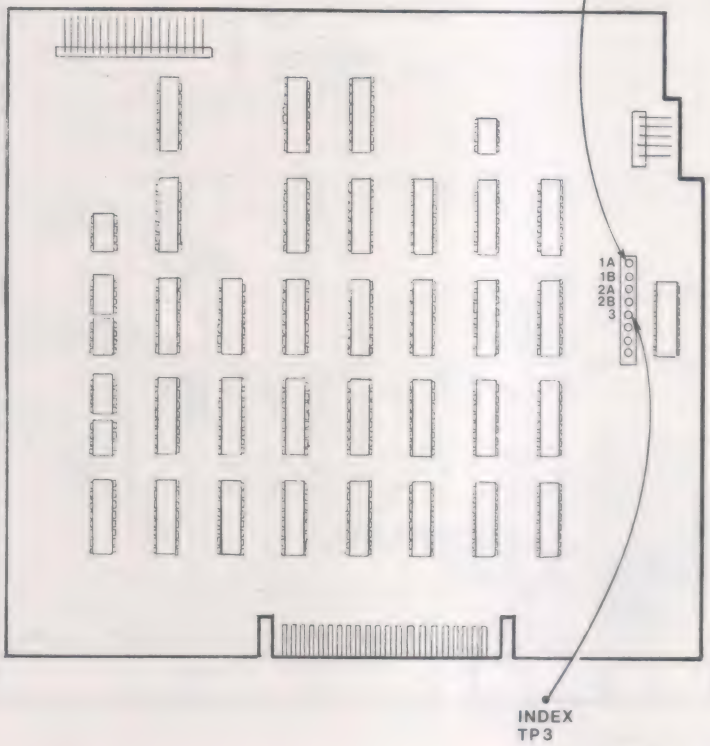


LYNX TECHNOLOGY INC.

SERVICE BULLETIN

BULLETIN No. QTP 08

QUMETRAK 842

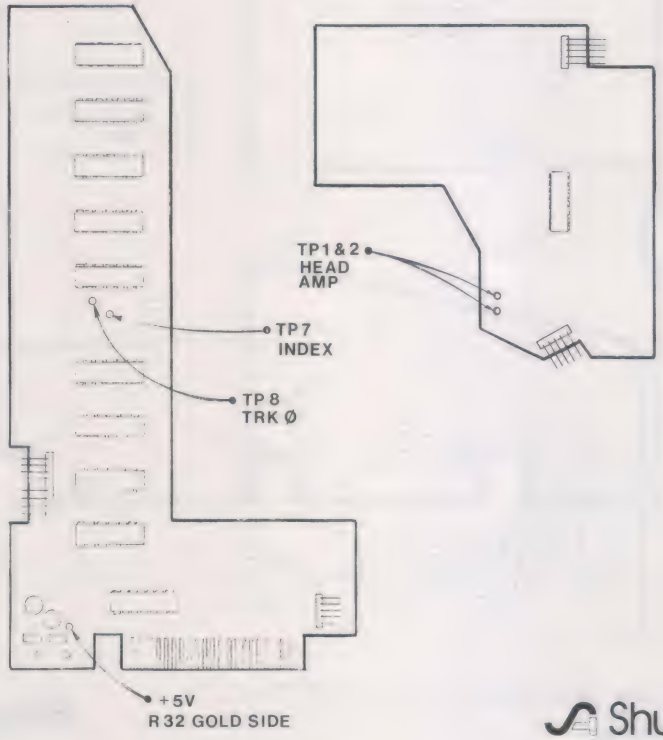


Qume.
A Subsidiary of ITT

SERVICE BULLETIN

BULLETIN No. STP 05

SHUGART SA-200

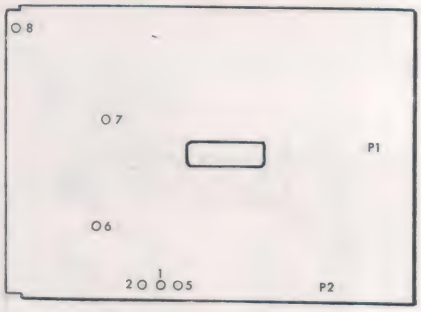


Shugart

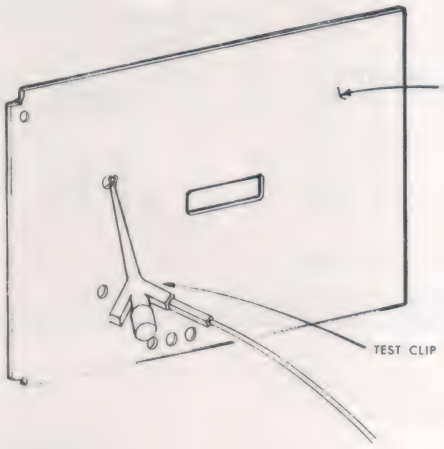
SERVICE BULLETIN

BULLETIN No. STP 10

SHUGART SA-300



TP1 and TP2 ANALOG READ DATA
TP5 GROUND
TP6 DIGITAL READ DATA
TP7 + INDEX
TP8 + TRACK 00 SENSE



Shugart

LYNX TECHNOLOGY INC

SERVICE BULLETIN

SHUGART SA 400

BULLETIN No. STP 07

5 1/4" SINGLE SIDED DRIVE TEST POINTS

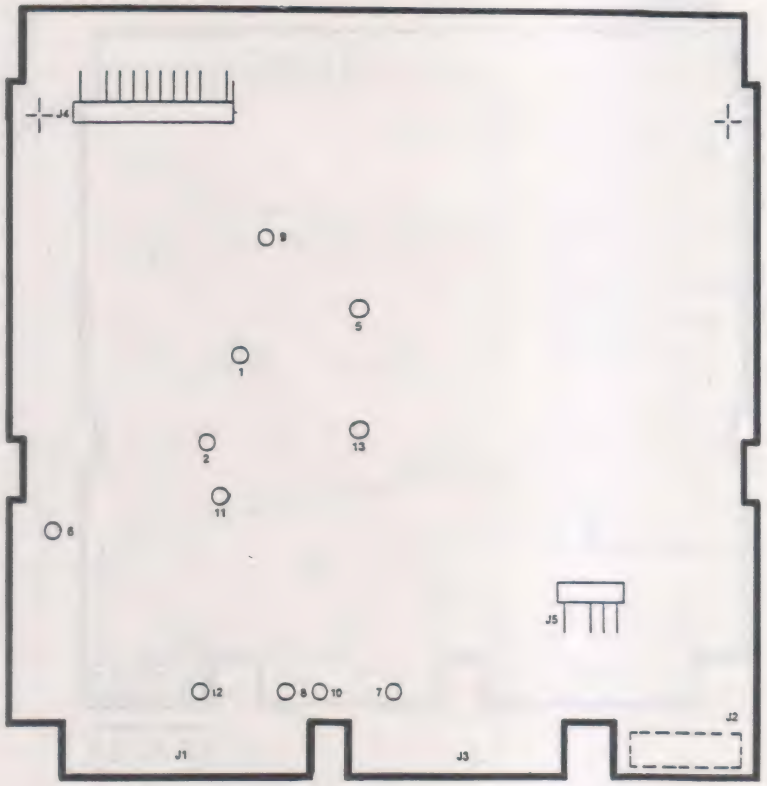
Shugart

LYNX TECHNOLOGY INC.

SERVICE BULLETIN

SHUGART SA 450

BULLETIN No. STP 09



Shugart

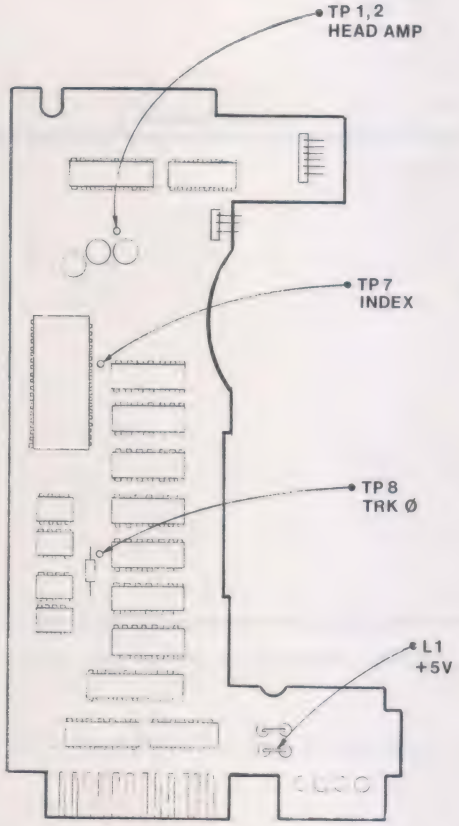
5 1/4 " DOUBLE SIDED DRIVE TEST POINTS

LYNX TECHNOLOGY INC.

SERVICE BULLETIN

BULLETIN No. STP 04

SHUGART SA-455



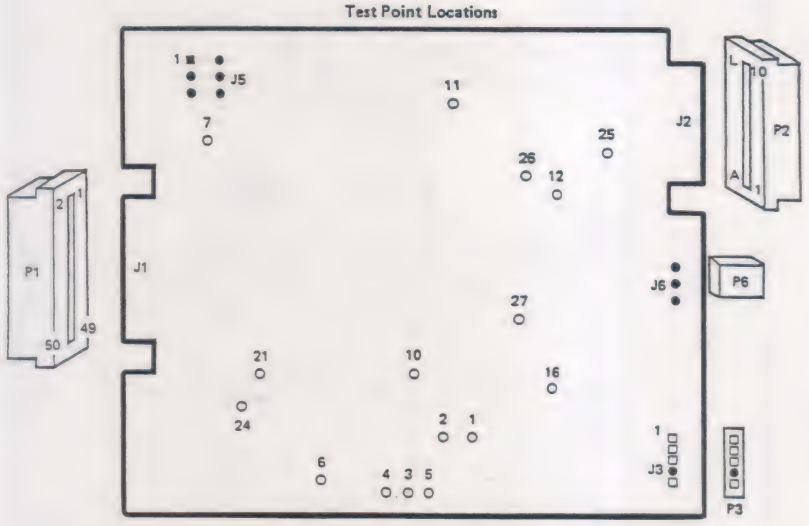
Shugart

SERVICE BULLETIN

BULLETIN No. STP 06

SHUGART SA 800/801

Test Point Locations



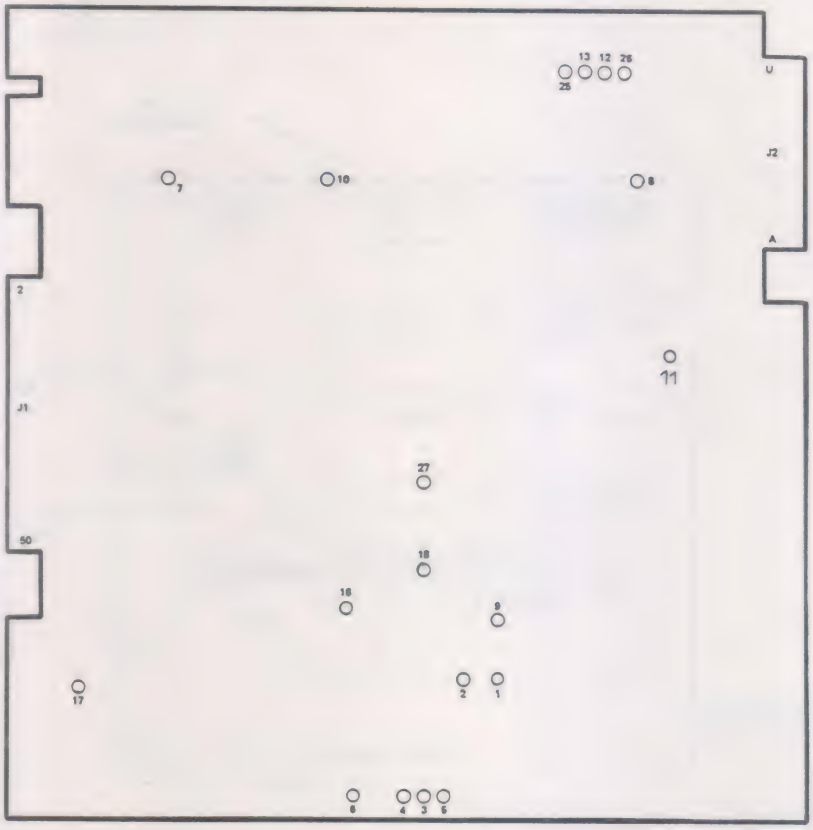
Single Sided Disc Drive PWA (8")

Shugart

SERVICE BULLETIN

BULLETIN No. STP 08

SHUGART SA 850/851A



DOUBLE SIDED DISC DRIVE PWA (8")

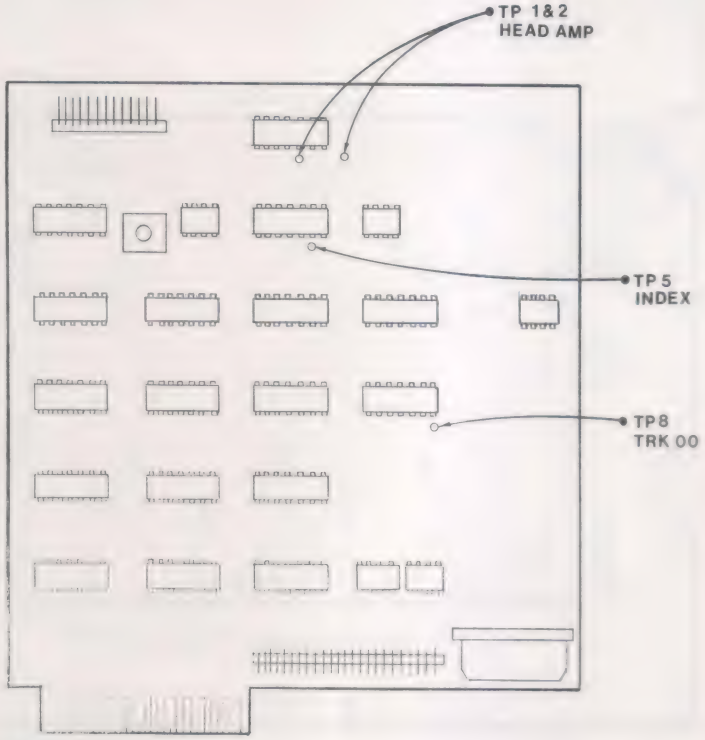
Shugart

LYNX

SERVICE BULLETIN

BULLETIN No. SETP 01

SIEMENS FDD 200-5



WST
WORLD STORAGE TECHNOLOGY
(Formerly Siemens)

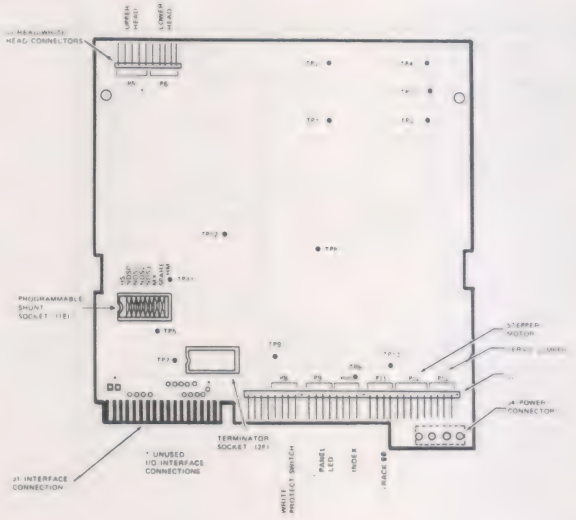
SIEMENS

SERVICE BULLETIN

BULLETIN No TTP03

TANDON TM 100-2

(IBM PC)



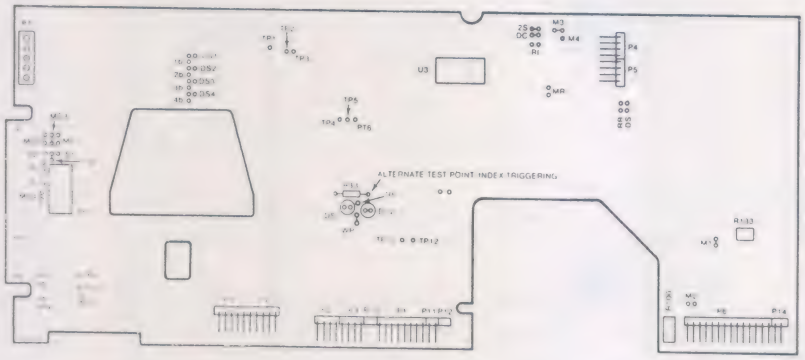
Tandon

IBM Personal Computer

SERVICE BULLETIN

BULLETIN No. TTP 02

TANDON TM 848-1, 848-2

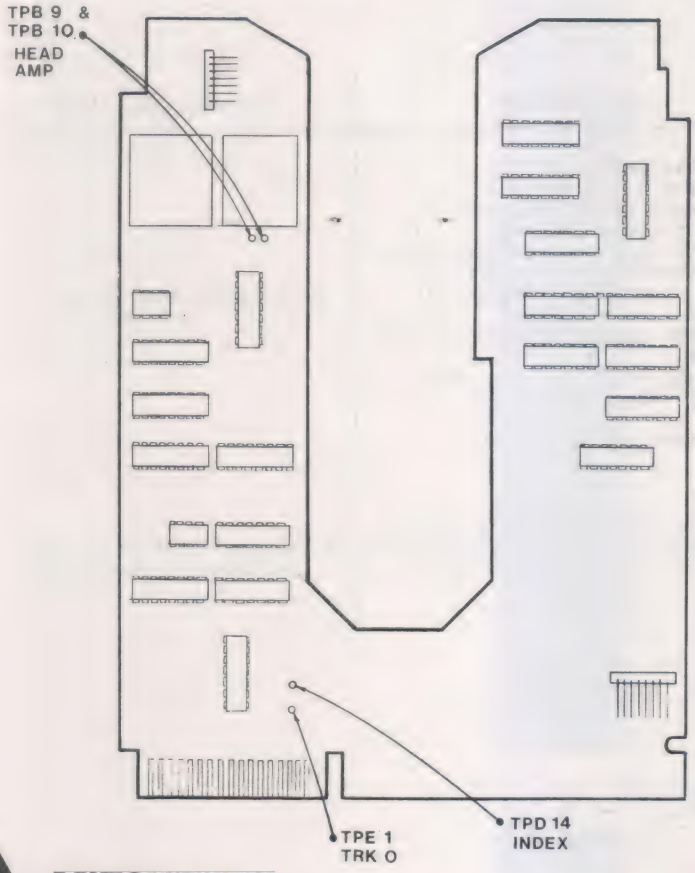


Tandon

SERVICE BULLETIN

BULLETIN No. TVTP 01

TELEVIDEO/
MITSUBISHI 4851/4853



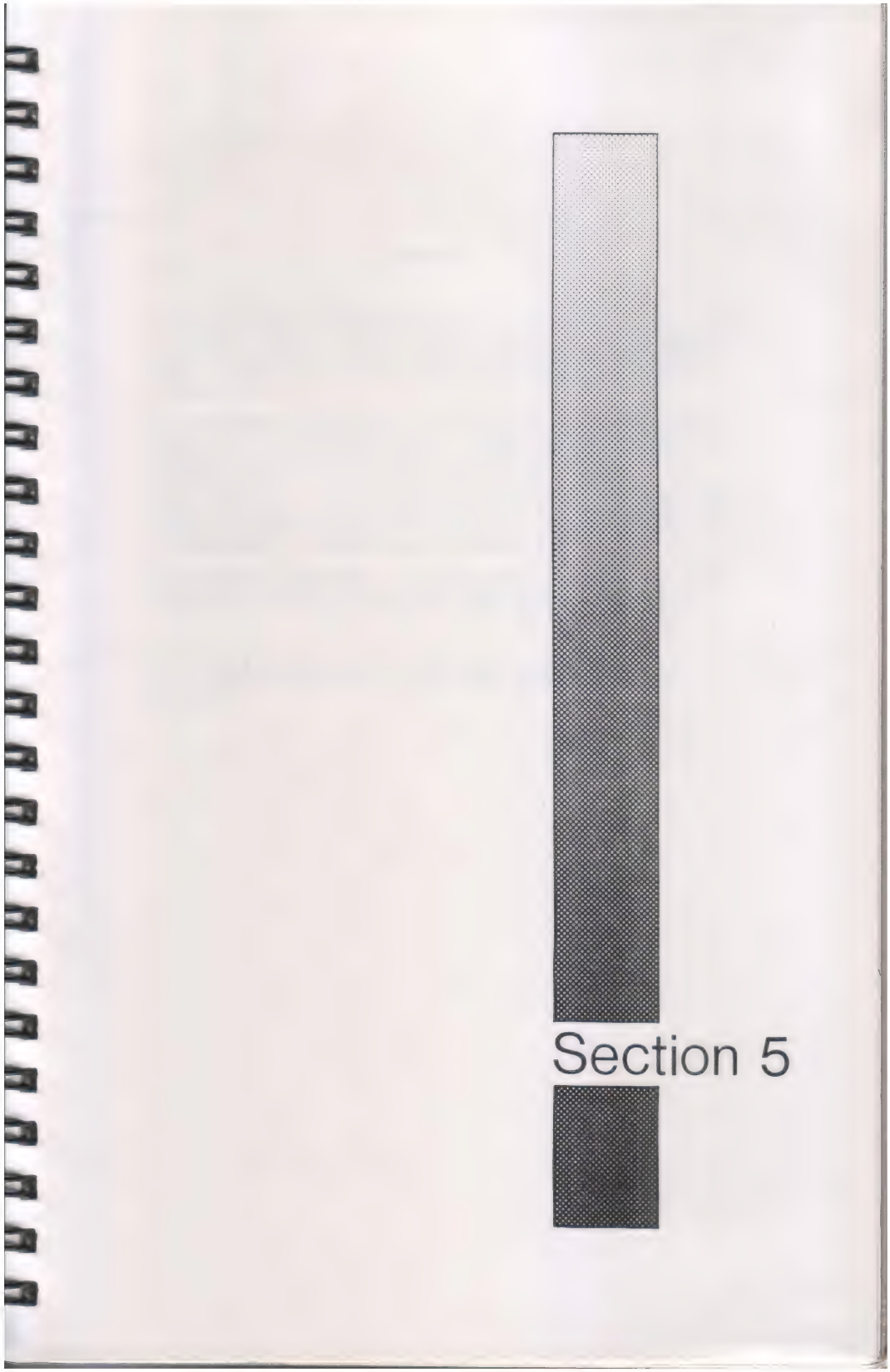
MITSUBISHI ELECTRONICS

TeleVideo Systems, Inc.

4F FIELD SERVICE REPORTS

4F.1 Following are excerpts from actual field service reports. These are not intended as a "stand alone" troubleshooting tool. Rather, the excerpts illustrate the generally non-technical analysis of disk drive problems by users. As well, they demonstrate the wide range of troubles that require an alignment procedure as the solution.

USER REPORT	TECHNICIAN ACTION
"drive problems" "drive not working" "system won't program" "read error problems" "long time to read data disk" "intermittent read errors" "machine (CRT) giving disk drive warning" "drive wiping everything off disk" "power wouldn't turn off- shadowing and errors" "system won't program"	• aligned disk drive
"disk drive squealing when in use"; "disk drive making loud sound and giving errors"	• aligned disk drive and replaced stepper motor


Section 5

SECTION 5

5A.1 WARRANTY

All instruments manufactured by Lynx Technology, Inc., are warranted against defects in materials and workmanship for a period of 90 days from the date of original shipment from the factory. This warranty excludes options and accessories.

In the event of any defects in material or workmanship, Lynx will, at its sole option, repair or replace the defective instrument covered by this warranty without charge. To obtain warranty service, the defective instrument must be returned during the applicable warranty period to Lynx properly packaged with transportation and insurance prepaid. We will reship at our expense only to destinations in Canada and the United States.

Any defect in material or workmanship determined by Lynx to be attributable to customer aleration, modification, negligence or misuse is not covered by this warranty.

5A.2 Lynx makes no warranty or representation with respect to the completeness of the information contained in this document.

5B REPAIR/RETURN INQUIRIES

Should the repair and/or return of any Lynx instrument become necessary, please contact the Lynx Customer Service department to obtain a Return Material Authorization (RMA) number. The designated RMA number should be marked on the **outside** of the return package. To avoid processing delays, please include:

- Purchase Order number
- Invoice number
- Returnee's name, address and telephone number
- Model and serial number
- Repair instructions

Notes

Notes

Notes

Notes

TECHNOLOGY INC.

1241 Denison St., Markham, Ont., Canada L3R 4B4 Tel. (416) 477-4020 Telex 06-986766